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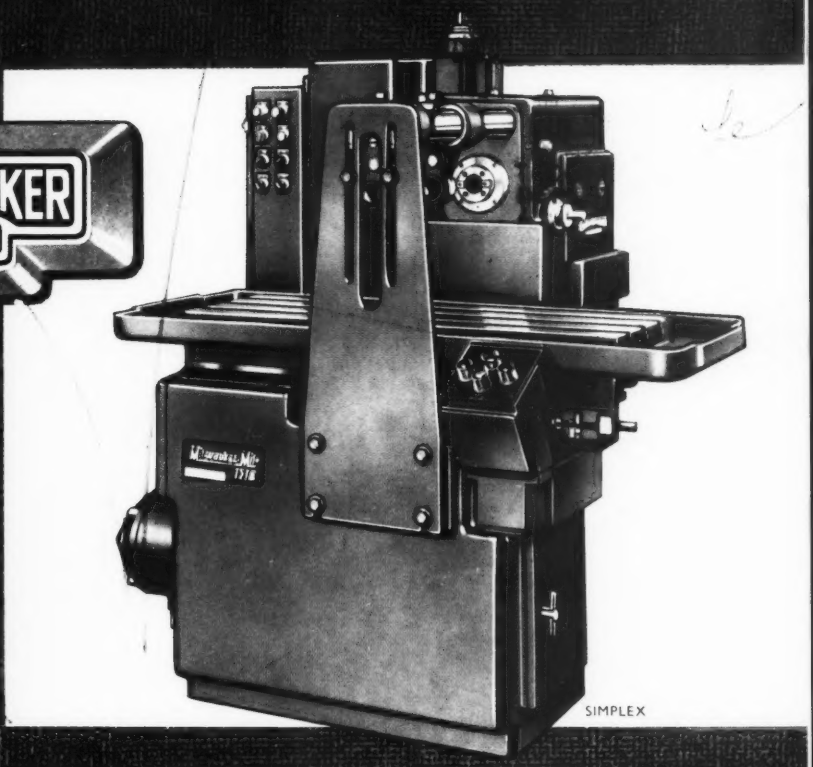

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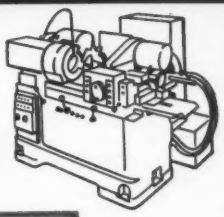
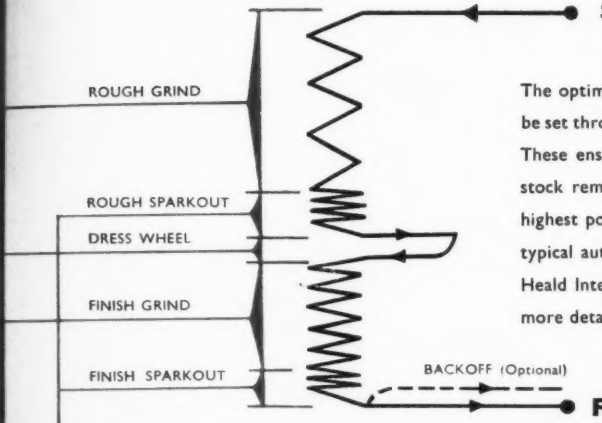
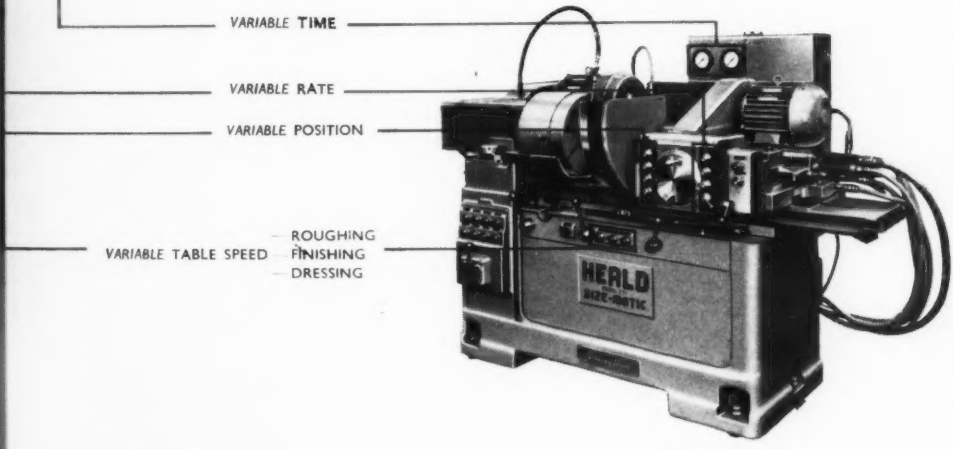




The optimum rate of production on any particular job can be set through a complete range of built-in *variable* controls. These ensure that the differing requirements of material, stock removal, size and surface finish are fully met at the highest possible production rate. The drawing illustrates a typical automatic grinding cycle available on many sizes of Heald Internal Grinders. We shall be pleased to send you more detailed information on request.



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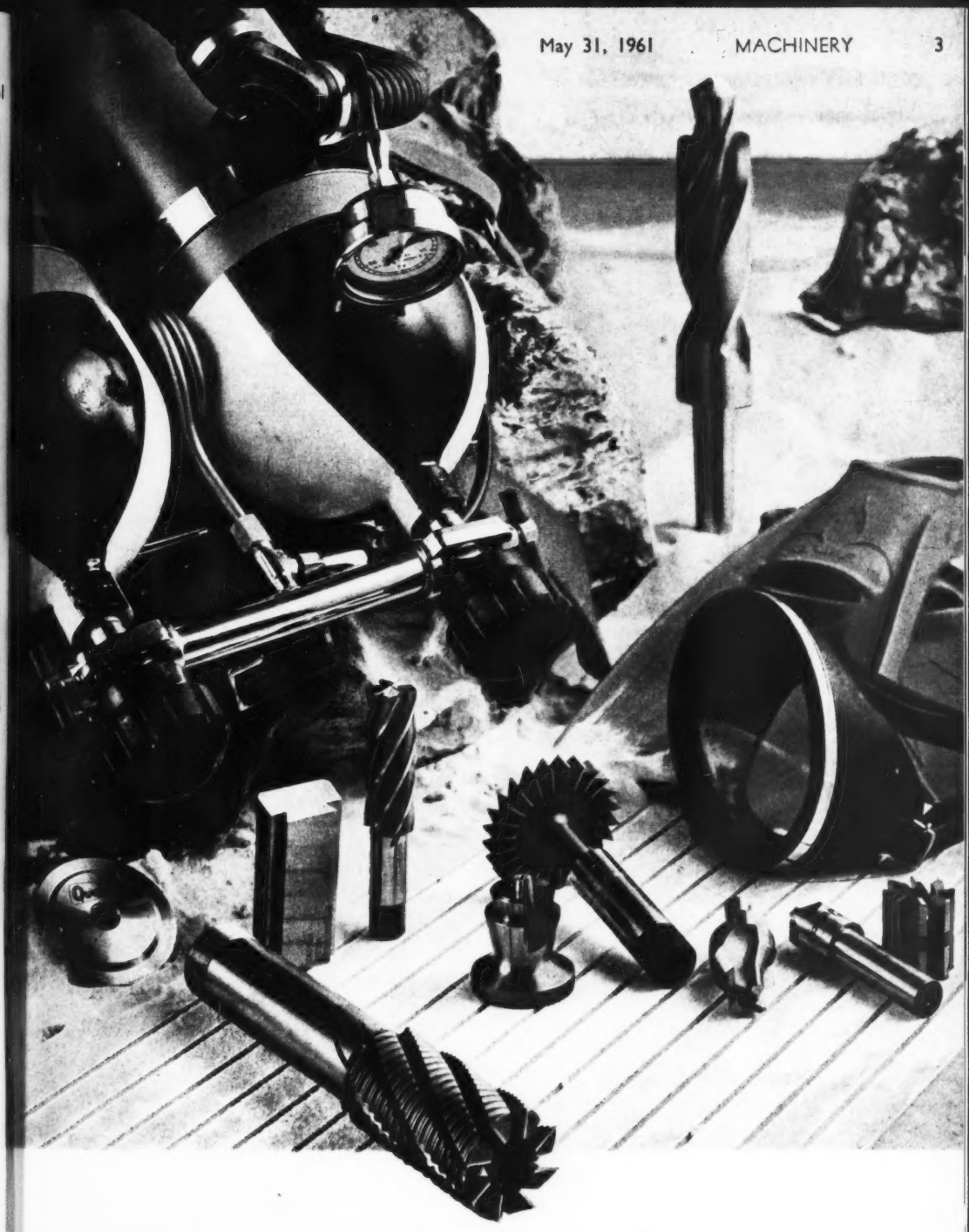

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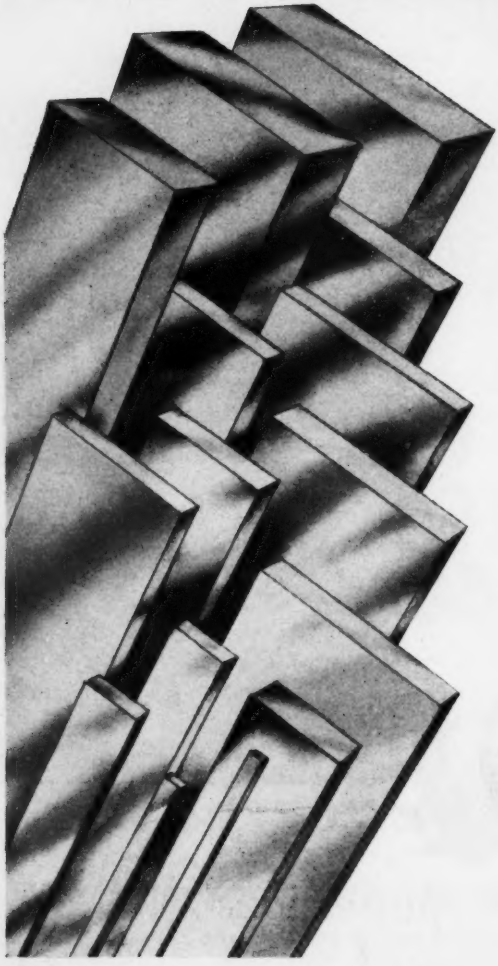

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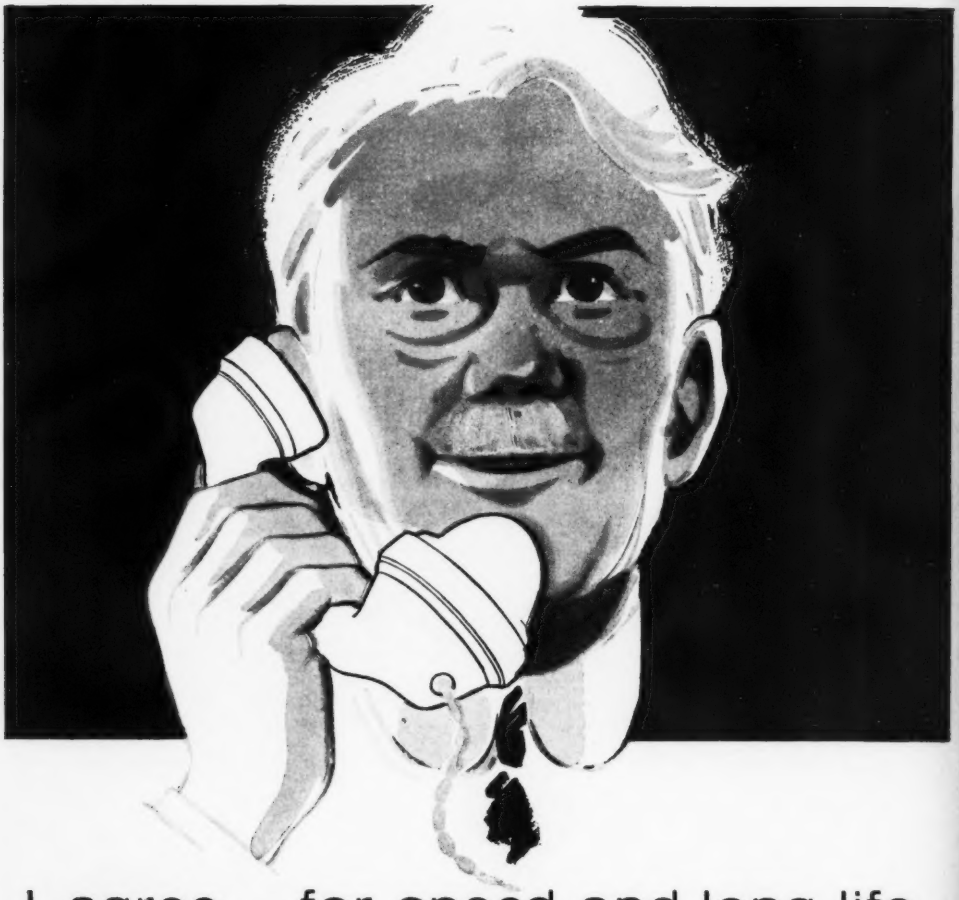

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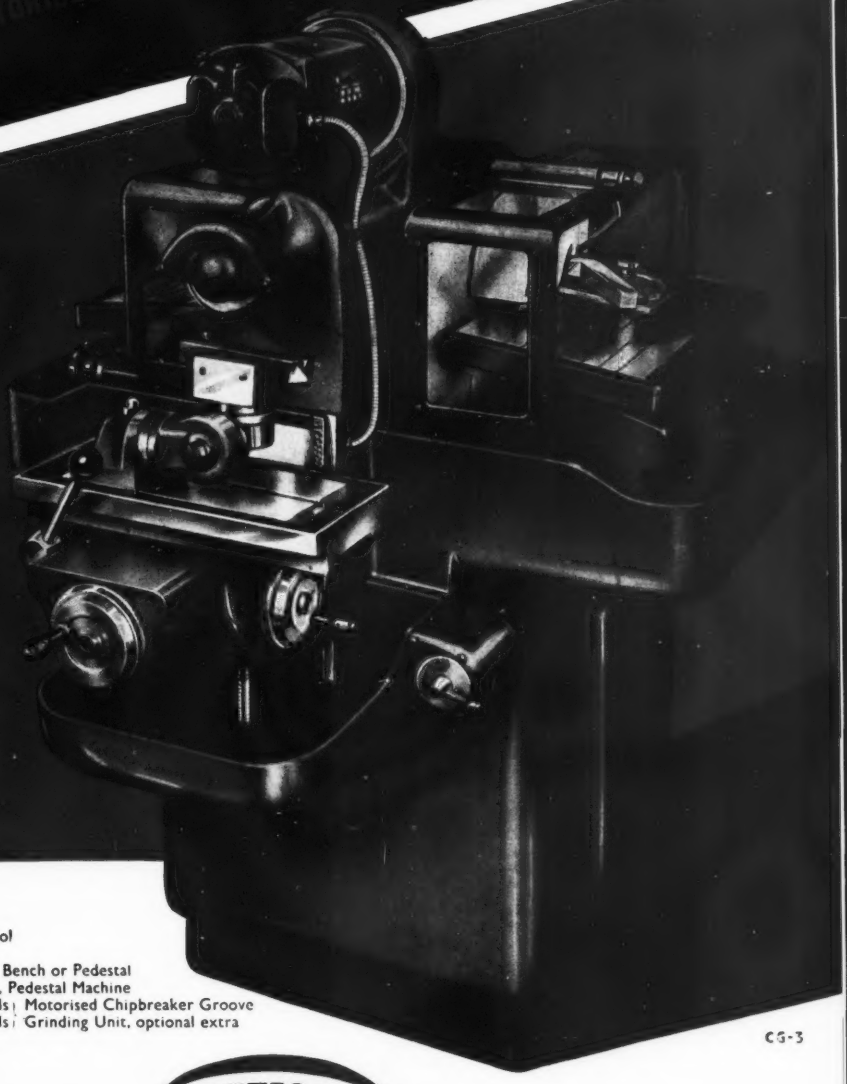
ABWOOD 'CONCENTRE' CARBIDE TOOL GRINDER



- Constant centre height of table to grinding point irrespective of angle
- Adjustable taper roller bearings eliminate end float
- Perspex panelled spray guards provide perfect vision, hinged for easy access to wheel
- Uses diamond wheels to their maximum efficiency
- The Chipbreaker Groove Grinding Unit accommodates turning tools of most shapes and sizes

Our full range of Carbide Tool Grinding Machines includes:
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CG-3

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Work positioning equipment with illuminated signal control of lateral dimension.

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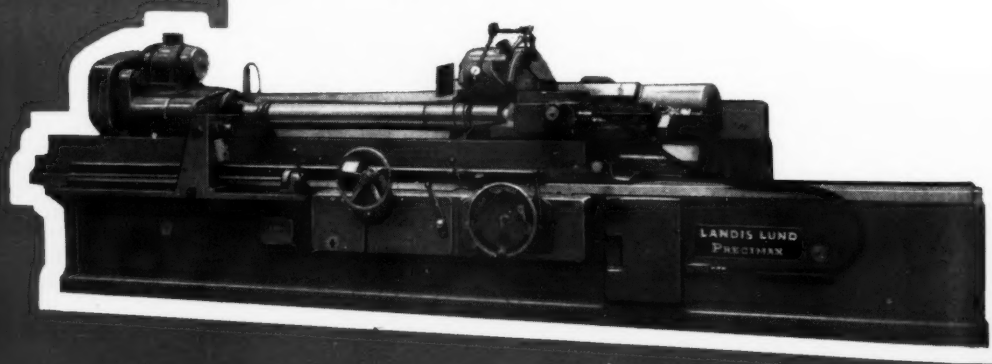

LANDIS LUND 14″ x 100″ TYPE HMPA CYLINDRICAL GRINDING MACHINE

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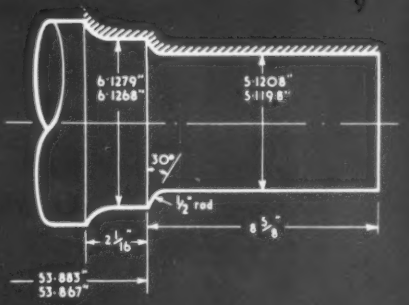

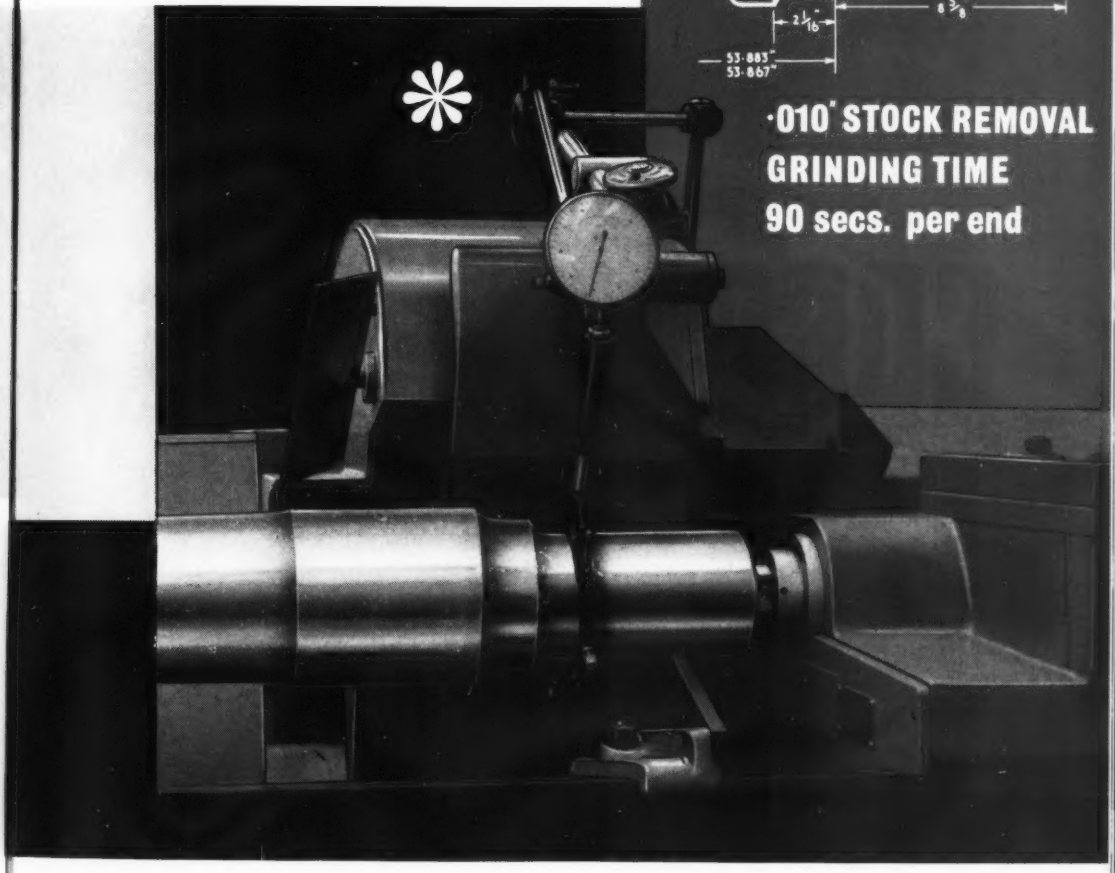

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90 secs. per end

finish grinding railway axles

Grinding twin diameters with blending radii and taper on LANDIS LUND 14" x 100" type HMPA Grinder at 5 minutes per axle, including all handling time.

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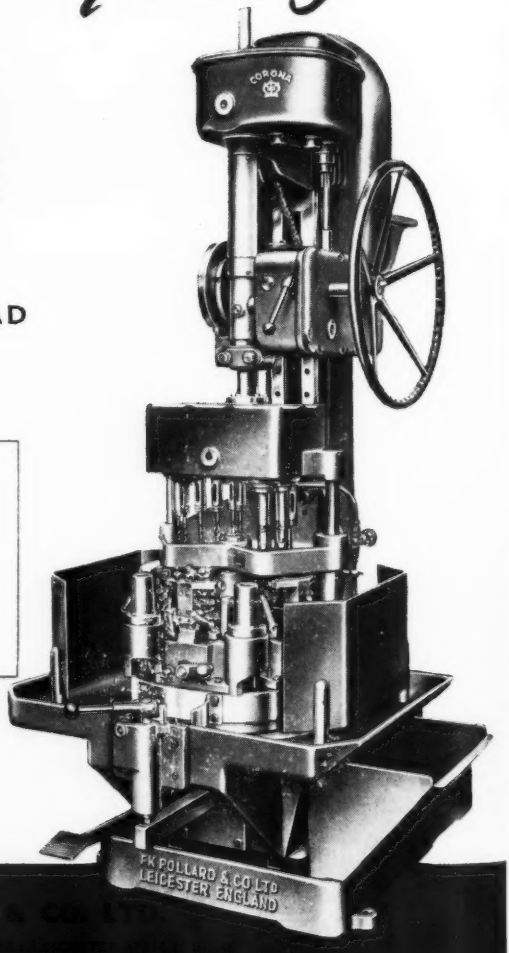

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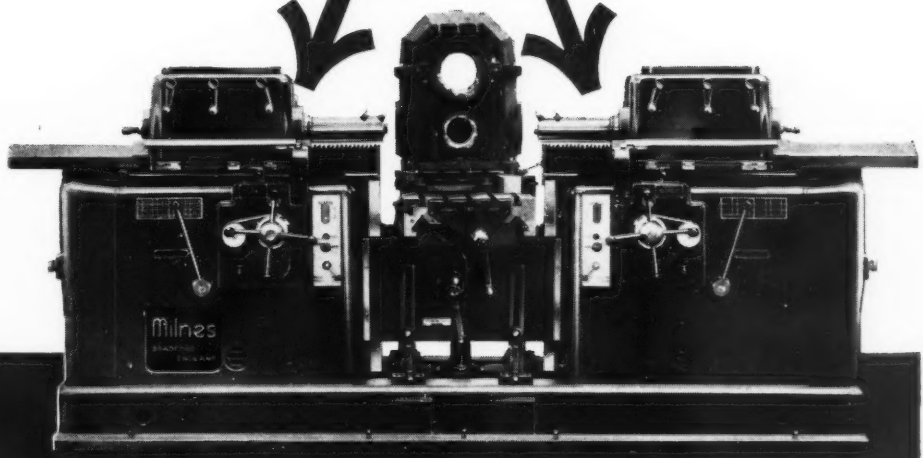

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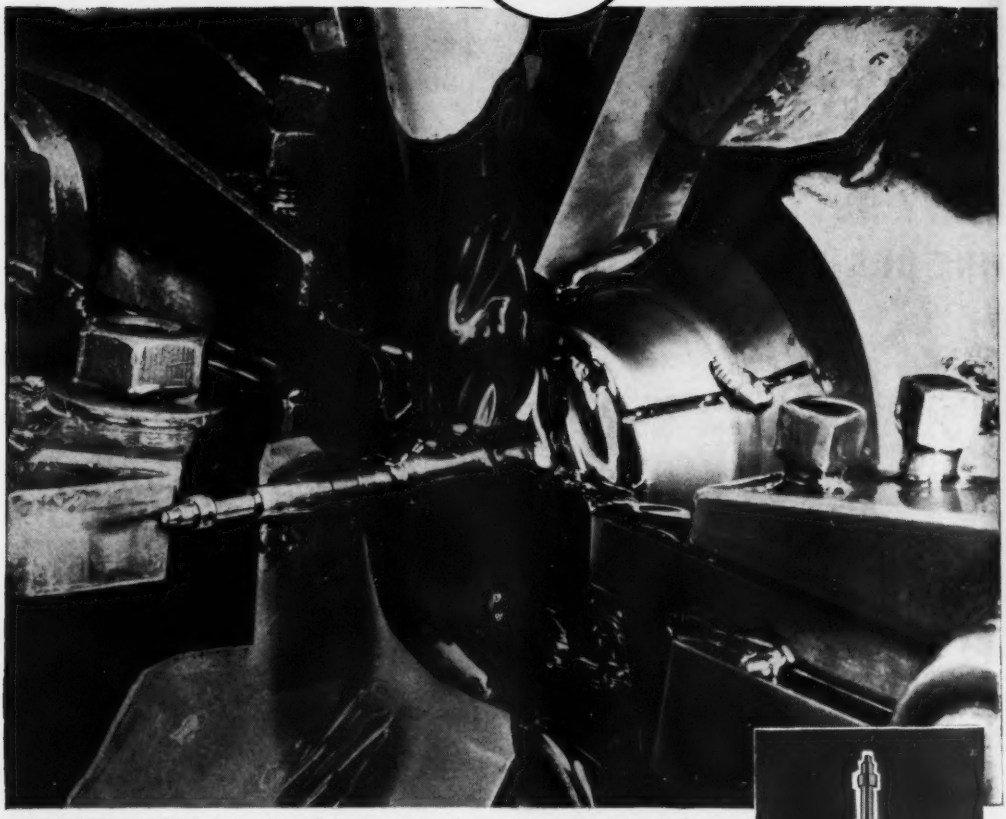
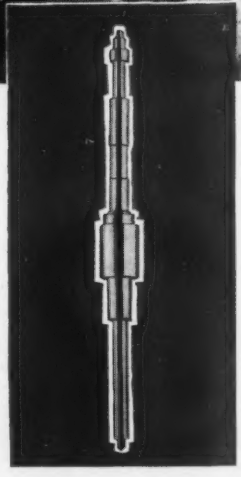
FERRANTI CHOOSE REGENT CUTTING OILS



SULTEX CUTTING OIL being used on a Peterman Automatic producing transmission staffs for electric meters. Operation involves 12 different shaft diameters. Tolerance 0.0015". Time cycle 3 minutes 40 seconds. Photograph taken in the works of Ferranti Ltd., Hollinwood, Lancs.



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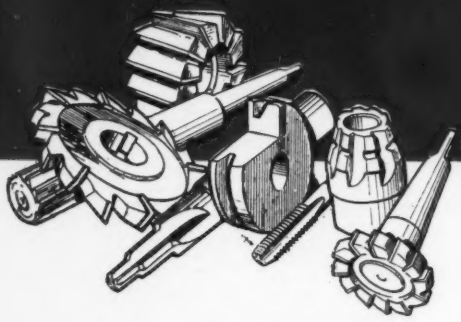
REGENT OIL COMPANY LTD., 117 PARK STREET, LONDON, W.1 REGENT



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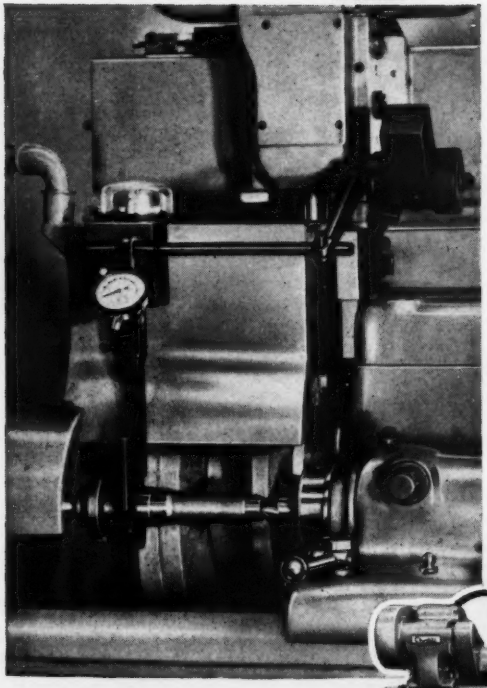

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Model 'BW' Plain Grinding Machine

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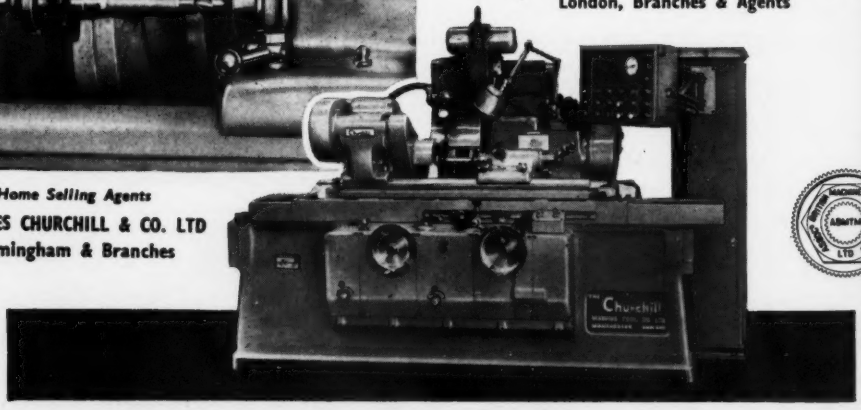

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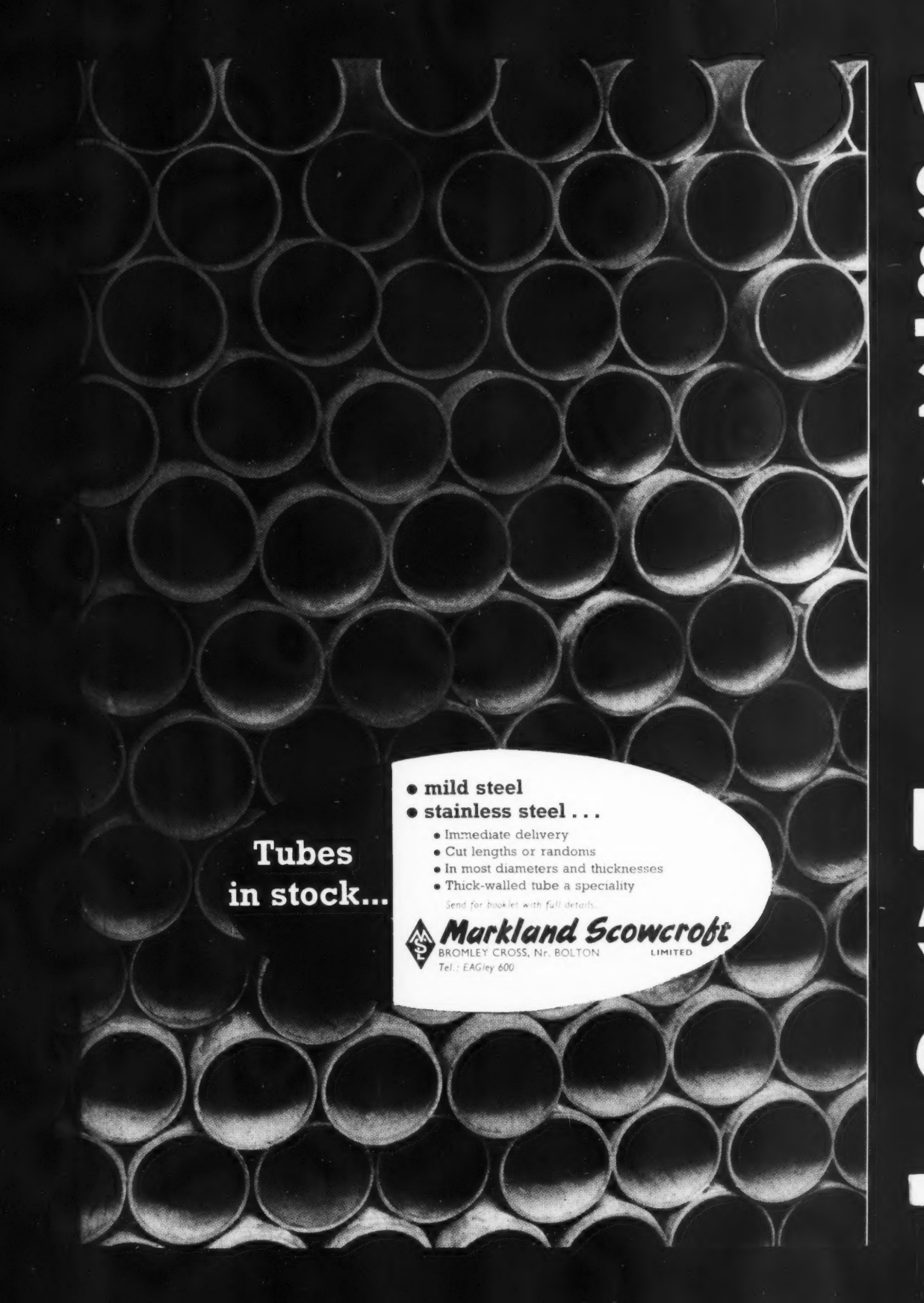
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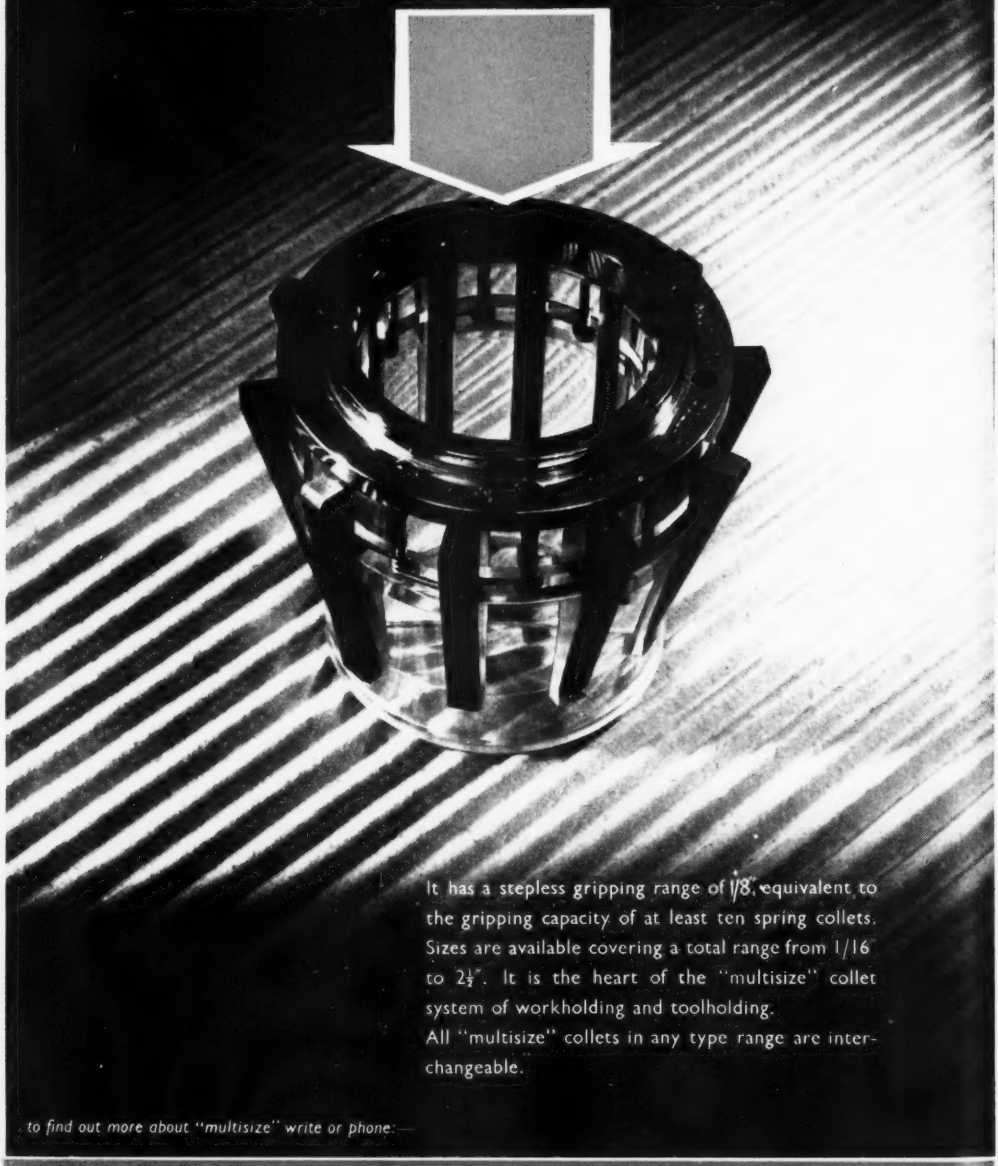
this is a "multisize" collet



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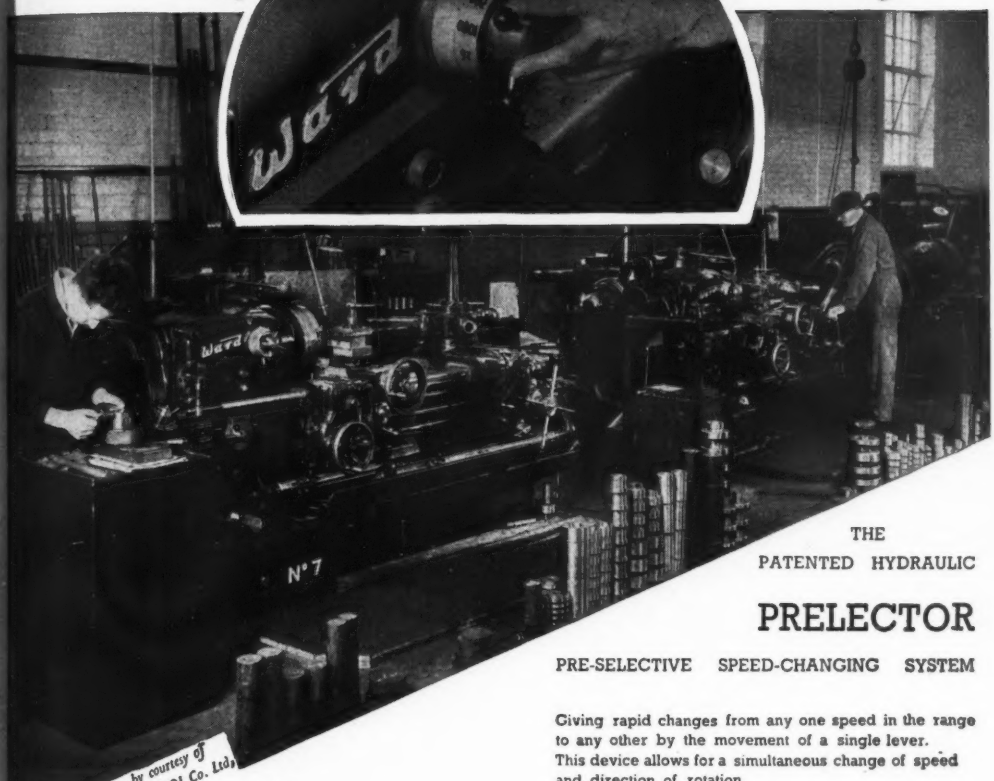

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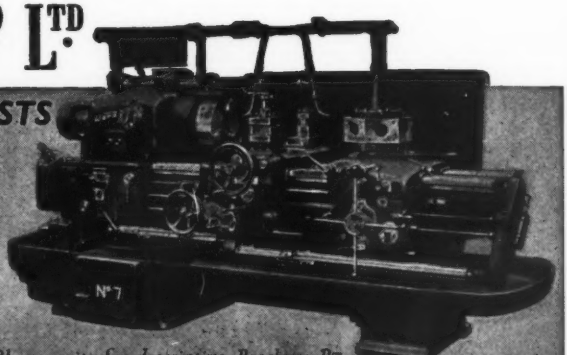

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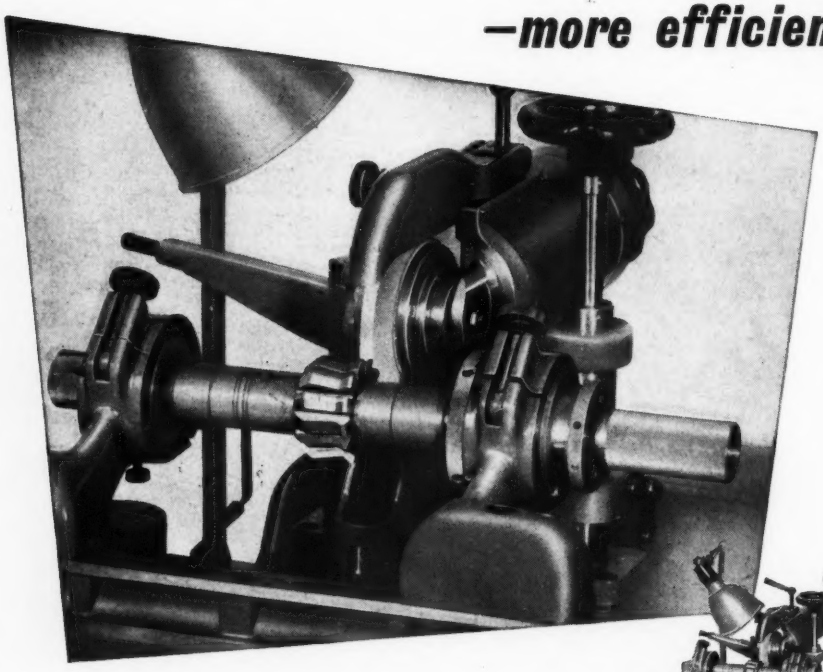
—more accurately
—more efficiently



SWISS

OERLIKON FS21

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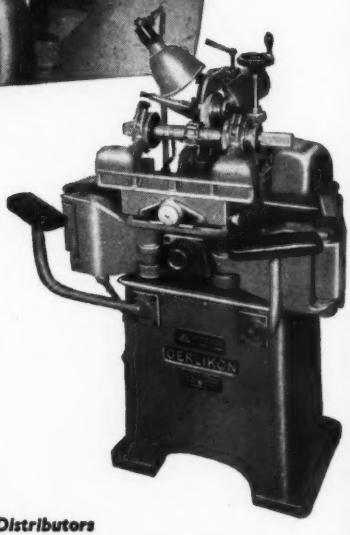

Note these advantages:

- Ensures profile accuracy and concentricity at the final operation — sharpening.
- Clearance angle can be varied to suit application.
- Constant land and tooth thickness can be maintained.
- Profile can be modified at any time.

MAX. DIA. 3½". MAX. LENGTH 11".
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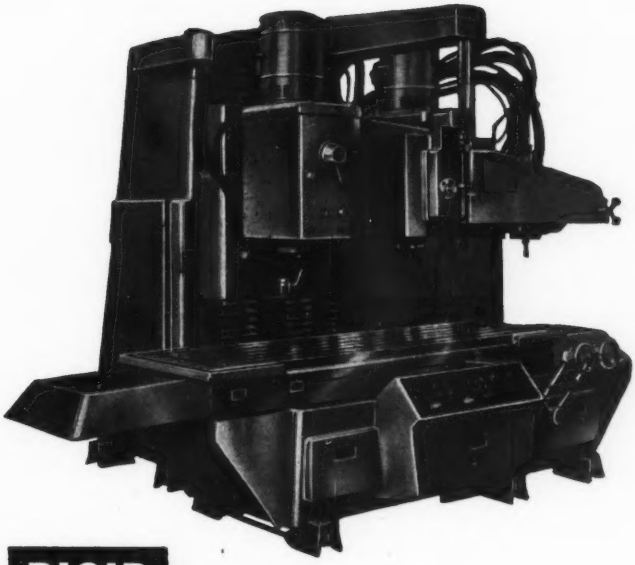

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AUTOMATIC HYDROCOPYING DIE SINKER MODEL KAB 250

Fully automatic — roughing and finishing — this exceedingly robust bed-type machine copies 3-dimensional dies, without supervision, from wooden or plaster models. Both left- and right-hand halves of the die can be copied at the same time from the same master. 360° profiling can be performed at constant feed, without rotating circular tables, *and* on vertical contours. Servo hand control permits speedy roughing. The machine has two spindles; single- and 4-spindle machines are available also.

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Copying feeds, steplessly variable ·4" to 15·75". Pick feeds ·006" to ·2".

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188

A USEFUL TABLE ON CUTTING OILS AND LUBRICANTS FOR THE MACHINE SHOP

Cut it out and keep it by you!

We give in the Table below the brand name, cutting oil or coolant recommended for metals in general use. An outline of the products named is as follows:

FRAPOL—Sulphurised and Sulpho-chlorinated neat oils for ferrous metals.

CUTMAX—Light-coloured non-sulphurised neat oils for non-ferrous and some ferrous metals.

EVCO—Special grades for individual needs including soluble and neat oils.

HOCUT—Translucent emulsion type coolants for all materials.

SOLCUT—High grade soluble oils for general machining.

ANTISEP—Water soluble E.P. base for heavy duty. Suitable for automatics if water mixture is required.

HOUGHTOGRIND—Clear chemical solution type grinding coolant for ferrous materials.

***NOTE:** *There are many metals and alloys not included in the Table for which special grades, neat and soluble, are available. Further details on request.*

*MATERIAL	*General Machining (Turning, Milling, Drilling, etc.)*		*Broaching*		*Tapping*		*Grinding*	
	Water Mixtures	*Neat Oils*	*Water Mixtures*	*Neat Oils*	*Water Mixtures*	*Neat Oils*	*Water Mixtures*	*Neat Oils*
Steels up to 50 tons per sq. in.	Solcut Antisep Evco	Frapol Cutmax	Broaching Paste	Frapol Evco	Solcut Evco	Frapol Evco	Hocut Houghto-grind	Frapol Evco
Steels over 50 tons per sq. in.	Solcut Antisep Evco	Frapol Cutmax	Broaching Paste	Frapol Evco	Solcut Evco	Frapol Evco	Hocut Houghto-grind	Frapol Evco
Cast Iron	—	Frapol	—	Evco	—	Evco	Hocut Houghto-grind	Frapol Evco
Stainless Steels Heat-resisting Alloys Nimonics Titanium	Antisep Hocut	Frapol Evco	—	Frapol Evco	—	Evco	Hocut Houghto-grind	Frapol Evco
Brass and Bronze	Evco	Cutmax	—	Cutmax	—	Cutmax	Hocut	Cutmax
Aluminium Alloys	Solcut Evco	Cutmax	—	Cutmax	—	Cutmax	Hocut	Cutmax

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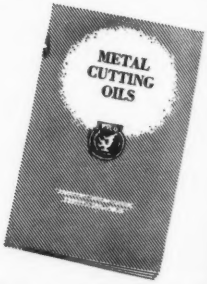
Works and depots at: Birmingham, London (Southall), Manchester, Liverpool, Bristol, Glasgow.



In association with the Houghton group of companies all over the world.

Research Service

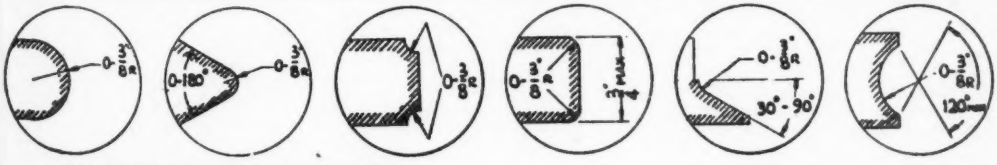
An interesting brochure on metal cutting oils is available on request.

the PG OPTIDRESS

for wheelforming under optical control without template

The unit is permanently attached to the head of the machine. One radial and two tangential straight line motions can be carried out in one setting. Additional wheel dressings are undertaken by operating the micrometer controlled cross slides, thus permitting the dressing of intricate profile combinations along the periphery of the wheel. The microscope facilitates quick and accurate diamond settings and the checking of the grinding wheel after dressing. Commercial diamonds can be employed since the radial dressing motion is viewed against a graticule.

Patent Pending on No. 36115/58



FOR GOOD FORM CHOOSE THE...

P. G. OPTIDRESS

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PRECISION GRINDING LTD

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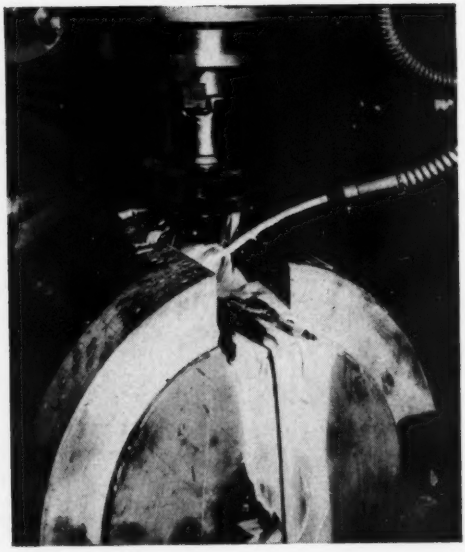
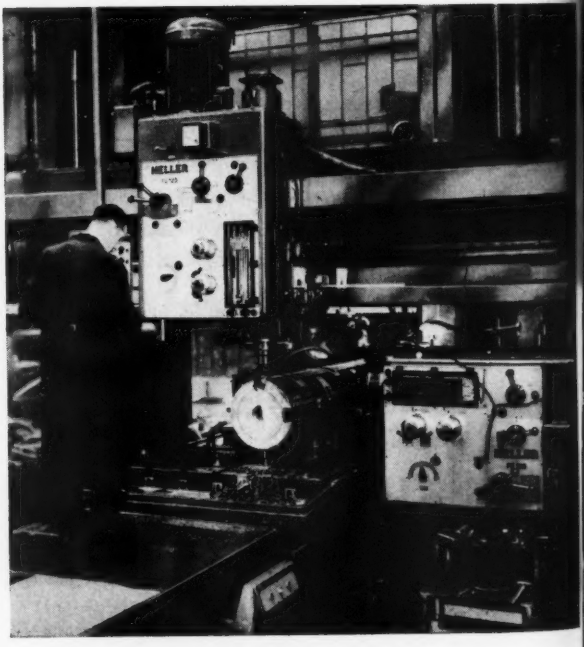


Clare

gets its teeth into the job

The outstanding performances achieved with the Clare System of Milling Equipment are ideally demonstrated on this Plano Miller at the Darnall Works of Davy and United Engineering Company Limited. Using a 3-flute routing cutter in a large 'F' size chuck on the vertical spindle, 3" wide x 2¾" deep slots in a 'Pay Off Reel Shaft are machined to full depth in one cut, prior to finishing, at a feed rate of 1" per minute at 80 r.p.m.



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WRIGHT STREET · BROADHEATH · CHESHIRE Tel: Altrincham 3701/2 Grams: Clarchucks, Altrincham

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Value for money?
Check these points

	3HG	4HG
✓ Horse Power	15	25
✓ Weight	4½ tons	well over 6 tons
✓ Table size	60" x 14"	72" x 17"
✓ Knee width	19"	25"
✓ Spindle bearings	5	5

- ✓ Positive backlash eliminator
- ✓ Suitable for tungsten carbide milling
- ✓ Suitable for high rake milling
- ✓ Duplicated controls and locks front and rear
- ✓ Every final drive gear bigger than the cutter it drives
- ✓ Infinitely variable feeds ½"—64" per minute
- ✓ Hardened table screw
- ✓ Automatic slide and screw lubrication
- ✓ 24 speeds from 23 to 1250 r.p.m.
- ✓ Built-in fly wheel

A&S

With so many important features designed to get the utmost out of your cutting tools, these heavy duty, precision built milling machines offer more value for money than any other miller of comparable weight and performance. Check the vital points of the 3HG and 4HG and see for yourself.

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MILWAUKEE

Registered Trade Mark in Great Britain.

BED TYPE production milling machine

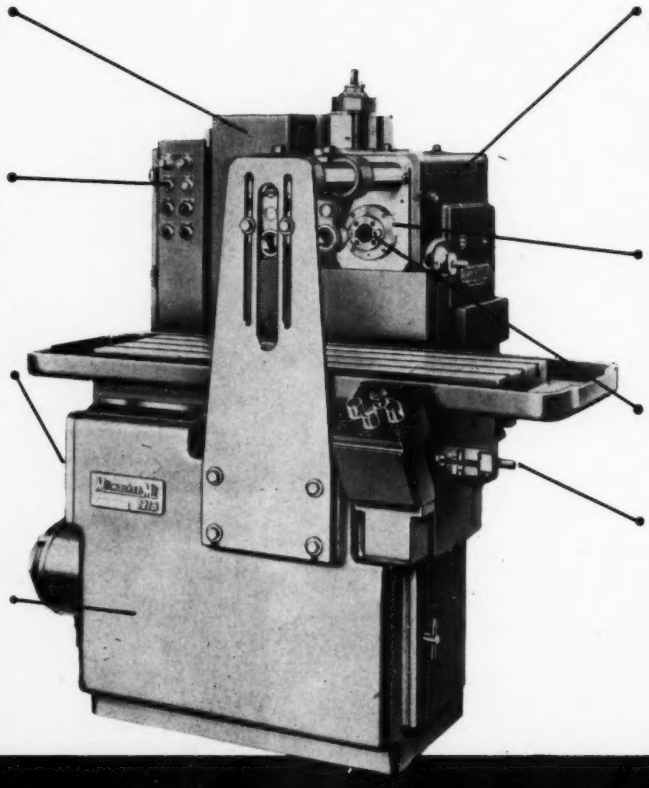
Designed for fast, accurate, profitable production of small to medium size parts.

UPRIGHT — rigid one-piece construction ... heavily ribbed to absorb vibration and torsional stresses imposed by high rates of metal removal.

POWER CONTROL STATION —conveniently located, compact grouping of switches which include master, spindle, table and coolant control.

TABLE FEED DRIVE—self-contained gear driven unit ... quiet, positive power transmission. Individual quick-action magnetic clutches control feed, rapid traverse and table direction.

BED—multiple box-section construction, heavily ribbed throughout *at all stress points to absorb the heaviest cutting forces* ... Integrally cast "square-wrap" table ways.



SPINDLE-HEAD —rugged compact design ... micrometer dial, graduated to .001", facilitates accurate manual positioning ... 12" vertical range ... double clamping assures rigid, positive settings.

SPINDLE QUILL —three inches of cross-adjustment ... quick, positive clamping.

SPINDLE—No. 40 N.S. taper ... three-bearing spindle.

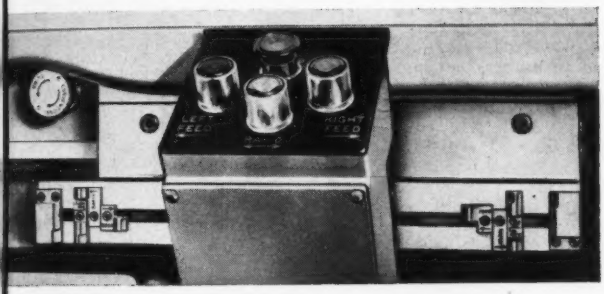
TABLE SCREW — has 126,000 p.s.i. tensile strength and a yield point of 100,000 p.s.i. ..... more than ample to move the load easily without distortion.

Choice of three horsepowers and speed ranges available—2 h.p., 25-750 r.p.m.; 3 h.p., 50-1500 r.p.m.; 5 h.p., 100-3000 r.p.m.—independent $1\frac{1}{2}$ h.p. feed motor —choice of three feed rate ranges—$\frac{1}{2}$ to 20 i.p.m.; 1-40 i.p.m.; $1\frac{1}{2}$-60 i.p.m. —horizontal feed range 18 inches - vertical feed range 12 inches.

Mil·waukee-Mil Model 1218

for SMALL, MEDIUM LOT and CONTINUOUS *Production*

CUTS SET-UP TIME



CENTRAL CONTROL GROUPING

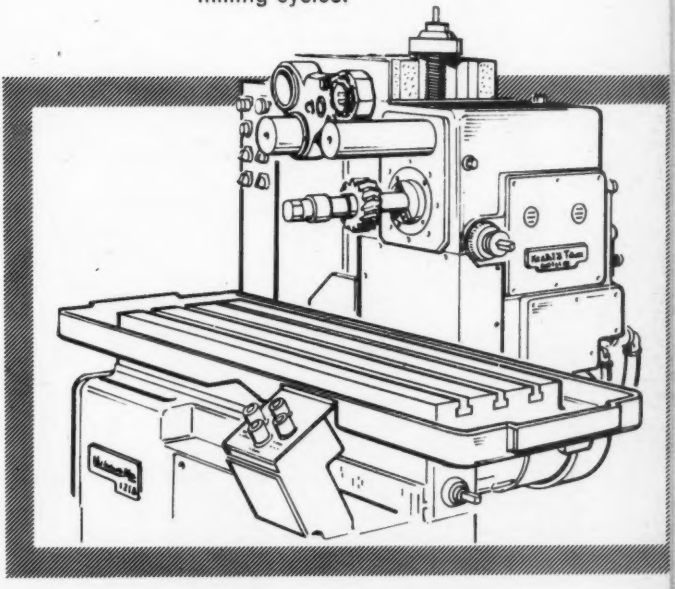
An outstanding example of operating convenience. A "twist of the wrist" effectively eliminates backlash for either conventional or climb milling. The compactly grouped push-button Operator Control Station facilitates control of all table movements.

Either manual or automatic cycle. Automatic cycle table control is based on an electrically coded system, with a minimum of basic styles of trip dogs, to create a wide range of automatic milling cycles.

EASE OF ACCESS

... TO CUTTERS AND ARBORS

Cutters and arbors can be changed WITHOUT removing arbor supports from overarms. Merely extend one overarm, slide arbor support forward on extended overarm, swing it up, move it back and rest it on the other overarm.



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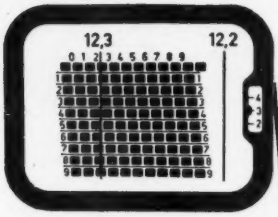
LONDON · BIRMINGHAM · GLASGOW · MANCHESTER · BRISTOL

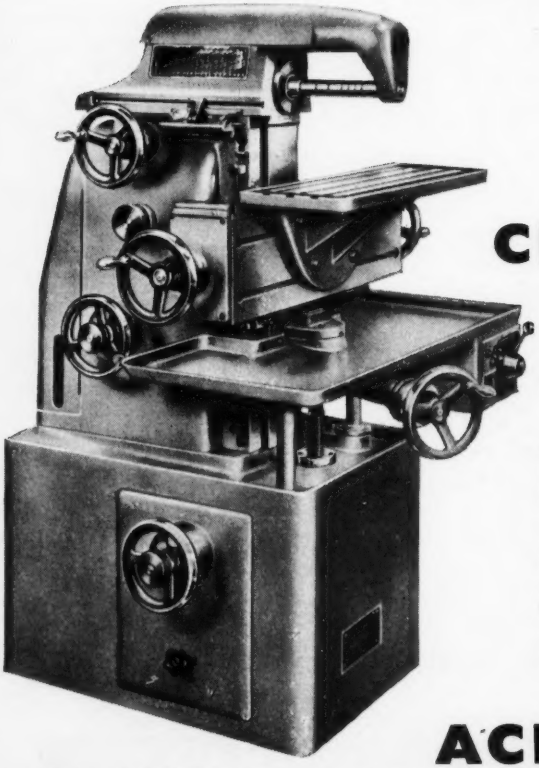
TWO SWISS PRECISION MACHINES

PERRIN
MODEL AV2
JIG BORER
WITH OPTICAL TABLE
Automatic Positioning Available



Two scales as shown controlling longitudinal and transverse settings

Boring capacity in cast iron 4in.
Table size 19⅝in. × 11in.
Longitudinal movement 16in.
Transverse movement 11in.
Max. distance spindle to table 18½in.
Infinitely variable spindle speeds from 60-3200 r.p.m. with power feed to spindle.



CHRISTEN UO-A
UNIVERSAL MILLING MACHINE
with Table swivelling in 3 planes
FOR HORIZONTAL & VERTICAL MILLING

Especially suitable for toolmaking and for high precision repetition work.

Infinitely variable speeds and feeds.

Longitudinal and vertical power feed to table.

Table size 26¾in. × 9in.

Large range of attachments available including vertical milling head, slotting attachment, universal dividing head, rack milling attachment, measuring equipment with slip gauges and dial indicators.

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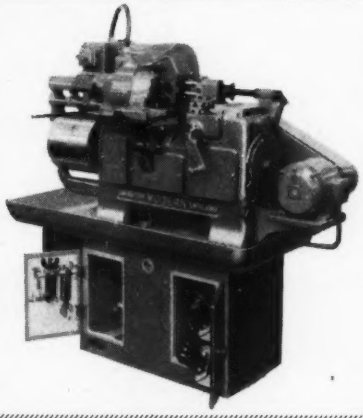
Simple Setting – High Production

with MODERN automatics



TYPE 904

CAPACITY

Round Bars. Dia.	$\frac{7}{8}$″
Hexagon Bars. A/F ...	0·71″
Square Bars. A/F	$\frac{9}{16}$″
Maximum Travel of Tailslide ...	2″
Maximum Travel of cross slide ...	$1\frac{3}{16}$″

SPINDLE SPEEDS

Speed Range ...	810-2,500 r.p.m.
No. of Speeds	14

TYPE 907

CAPACITY

Round Bars. Dia.	$1\frac{1}{4}$″
Hexagon Bars. A/F	1·01″
Square Bars. A/F	$\frac{7}{8}$″
Maximum Travel of Tailslide ...	$2\frac{1}{2}$″
Maximum Travel of cross slide ...	$1\frac{3}{8}$″

SPINDLE SPEEDS

Speed Range ...	280-1,900 r.p.m.
No. of Speeds	12

Modern Machine Tools Ltd

P. O. BOX 56 · GOSFORD STREET · COVENTRY

Telephone: Coventry 22132/6 Cables: 'Modern' Coventry

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HELPING TO KEEP LONDON TRANSPORT MOVING

London Transport, with more than 8,000 road vehicles in service, have a real problem in repair and maintenance. At their Chiswick Works engines and other units are received for stripping down to component parts for reconditioning. Here two METCO Flame Spray Guns are operating, building up undersize journals, housings, shafts, bearings, etc., to permit machining to the original size. The illustrations opposite are typical of the work being done. Because the metallizing process is economical and speedy, the 'float' of spares is considerably reduced, and by maintaining the original size standardization is unaffected.

If you have a problem of wear or corrosion, you must investigate flame-spraying. There is a booklet giving information on METCO Processes and we would like to send you a copy.

Please let us know where to mail it.

METCO

REGISTERED USER

FLAME SPRAY EQUIPMENT AND SUPPLIES

METALLIZING — ThermoSpray — PLASMA

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Please send me further information on the METCO Flame-Spray Processes.

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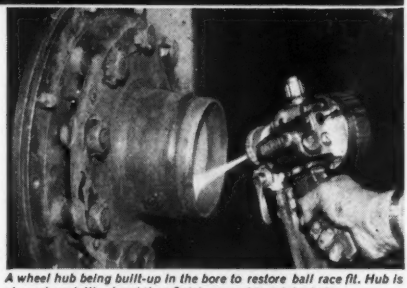
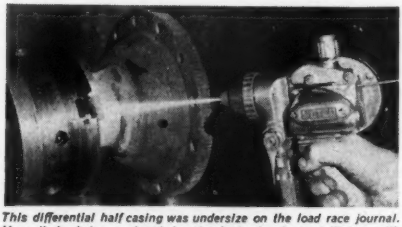
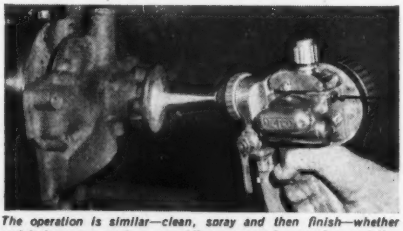


A wheel hub being built-up in the bore to restore ball race fit. Hub is cleaned, metallized and then finish ground to original size.



This differential half casing was undersize on the load race journal. Here it is being restored to standard size by metallizing with SPRASTEEL L.S. to a thickness of approximately '020".

Starter motor driving pinion shaft being sprayed with SPRABOND WIRE—a hard, wear resistant material—before being ground to finished size.



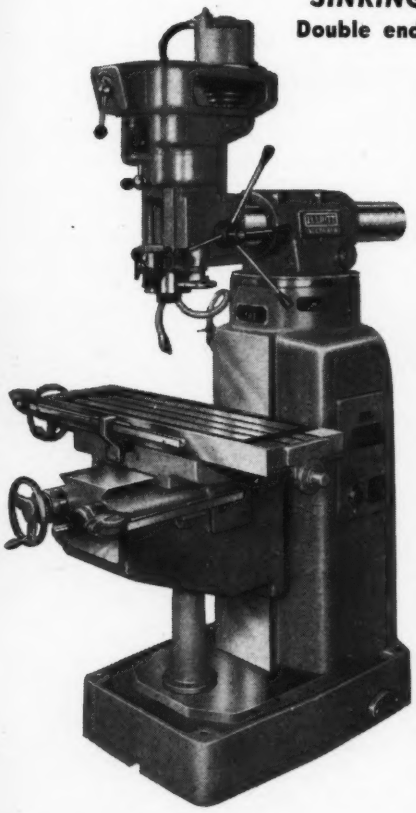
The operation is similar—clean, spray and then finish—whether reclaiming worn parts or providing wear and corrosion resisting surfaces on new components during production. The illustration shows a water pump body.

ELLIOTT
VICTORIA

TURRET MILLING MACHINES

MODELS TR1, TV1 & TV2 for MILLING · DRILLING · BORING · DIE SINKING · END MILLING · KEYWAY CUTTING

Double ended overarm now standard on Models TV1 & TV2

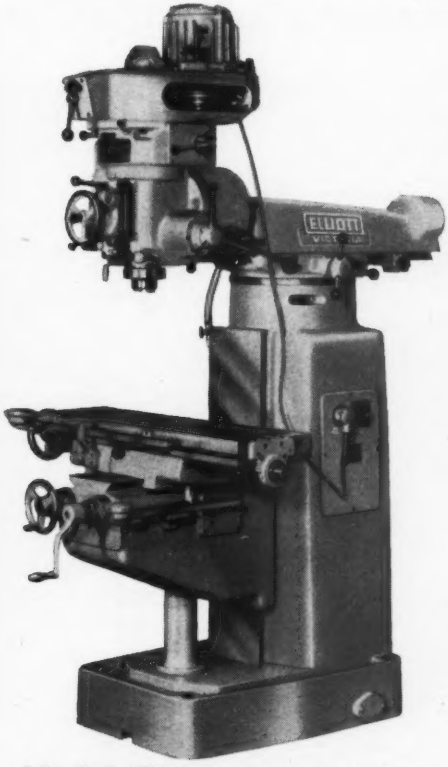


Model TR1 *TABLE SIZE 36" x 10½"*

5" dia. round overarm, rotated for angfular setting of the head.

Rugged base casting, precision ground bearing areas.

Head powered by 1¼ h.p. motor.



Model TV2 *TABLE SIZE 36" x 10½"*

Similar to model TR1 but fitted with heavier type head, powered by 1½ h.p. motor. Longitudinal power feed unit, motorised slotting attachment and motorised punch shaping and slotting attachment, available as extra equipment.

Manufactured by:

B. ELLIOTT (MACHINERY) LTD

(MEMBER of the B. ELLIOTT GROUP)
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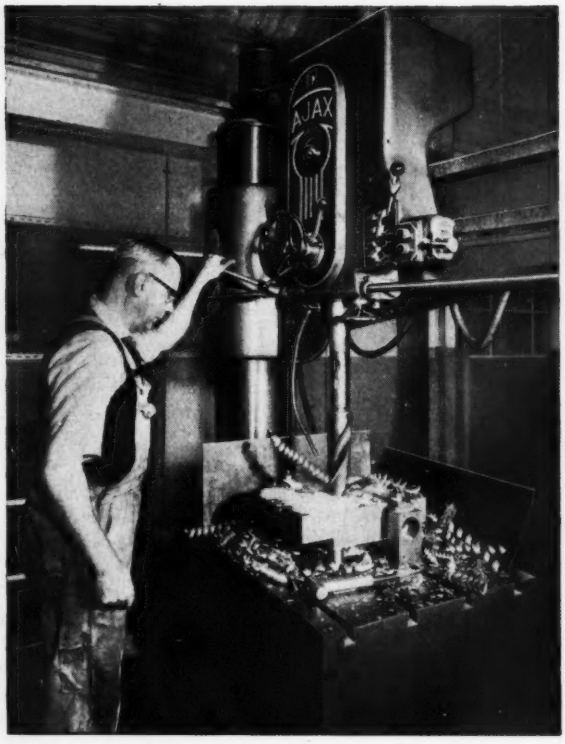
ELLIOTT OF LONDON GROUP

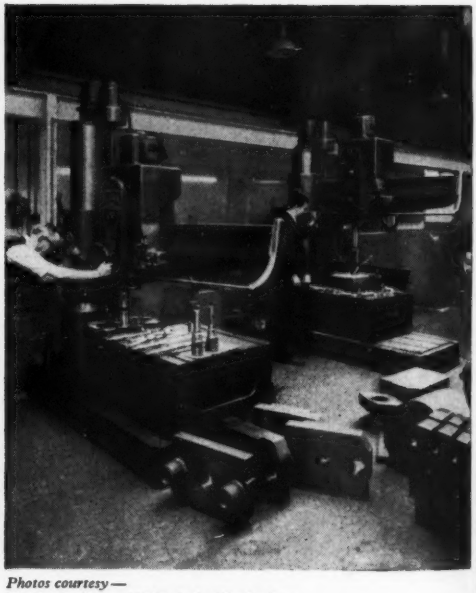
NRP 2714

"SPEEDY" and accurate drilling with AJAX AJ4 RADIAL

SPEEDY & EYNON (1951) LTD CUT PRODUCTION COSTS!



In the machine shops of Messrs. Speedy & Eynon (1951) Ltd, of Birmingham, AJAX AJ4 Radial drills ensure speedy and accurate drilling on many products. Jobs previously machined on jig borers are now carried out on AJAX MACHINES. Just another example of — AJAX RELIABILITY.



Photos courtesy — Speedy & Eynon (1951) Ltd., Birmingham.

BRIEF SPECIFICATION

- 3″ drilling capacity in steel.
- 4′ 6″; 5′ 0″; 5′ 6″ arm.
- Spindle No. 5 M.T.
- Rotary gear speed change.
- Choice of three speed ranges.
- Coolant equipment as standard.

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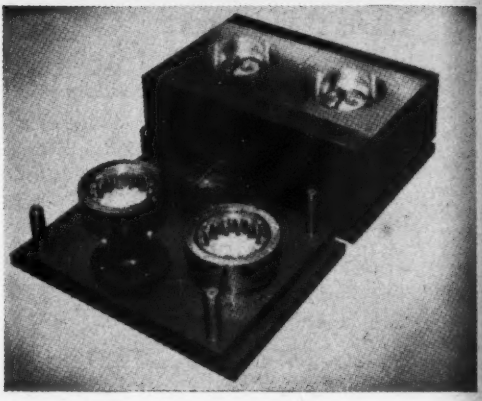
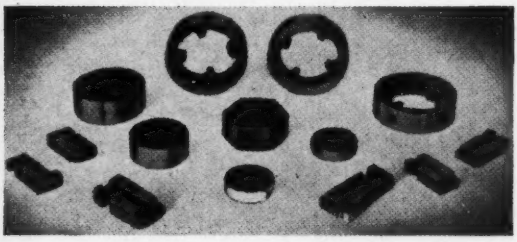
SPECIAL ALLOY TOOL STEELS

Details are given below of three of the ranges of Edgar Allen's special alloy tool steels. Other steels are of course, covered in our Special Alloy Tool Steels booklet and Stocklist. Please write for details using the request form.



COMPRESSION MOULDS IN DOUBLE SIX STEEL

If the duty is severe Double Six super die steel is recommended. The extra cost being recovered over and over again in the extra production life of the tool. The high alloy composition ensures that the cutting edge lasts much longer than ordinary steel.



SCREWING DIES, CHASERS, ETC., IN K9 STEEL

This steel has been perfected to meet the needs for inexpensive non-shrinking steel suitable for tools requiring the highest accuracy. K9 gives long production runs with minimum regrinding and can be used for dies, stay taps, plugs and gauges.

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Minerva Tool steels are easy to manipulate, with a simple oil-hardening heat treatment, despite their special alloy content. Both steels hold a good cutting edge and are extremely resistant to wear. The H.C. grade being slightly harder.

Minerva L.C. for chisels, pneumatic percussion and boilermakers' tools.

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Edgar Allen & Co. Ltd. : Sheffield 9

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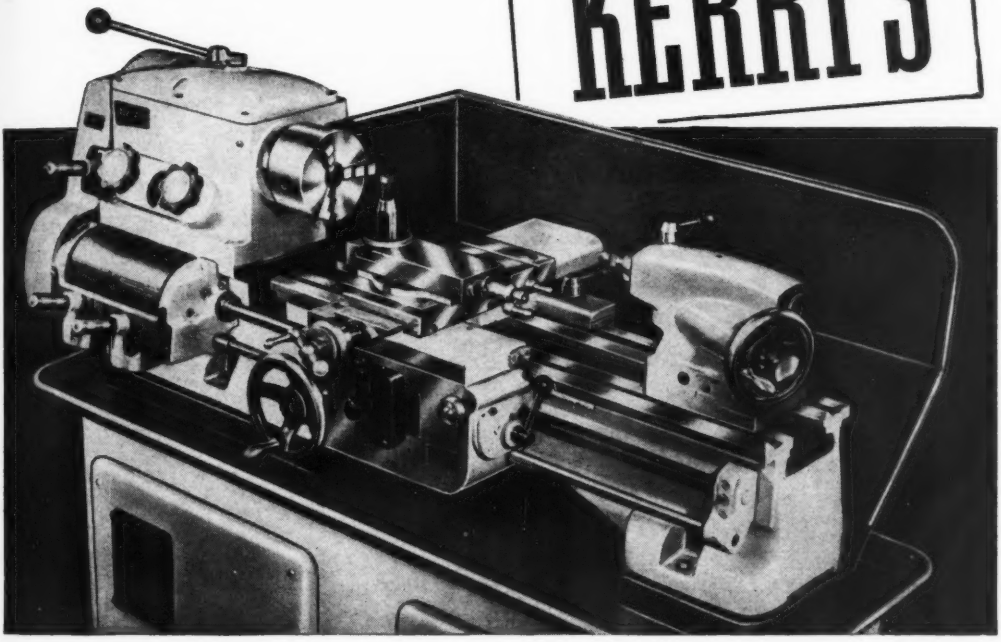
MORE AND MORE ARE TURNING TO KERRY'S



11" SWING LATHES

THOUSANDS in use in Great Britain and throughout the World!

★ SLIDING, SURFACING AND SCREWCUTTING LATHE

★ ALL GEARED HEADSTOCK GIVING 9 SPEEDS RANGING FROM 39-1500 r.p.m.

★ TYPE LOO PRECISION TAPERED SPINDLE NOSE

★ FEED BOX GIVES 64 PITCHES AND 7 FEEDS FROM ·0004 In.-·024 In.

★ CAMLOCK TAILSTOCK

★ BEDWAYS AND SLIDES PRECISION GROUND

★ HARDENED BEDWAYS OPTIONAL EXTRA

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manufactured within the KERRY GROUP by
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GRANGE ROAD, LEYTON, LONDON, E.10

A Kerry COMPANY

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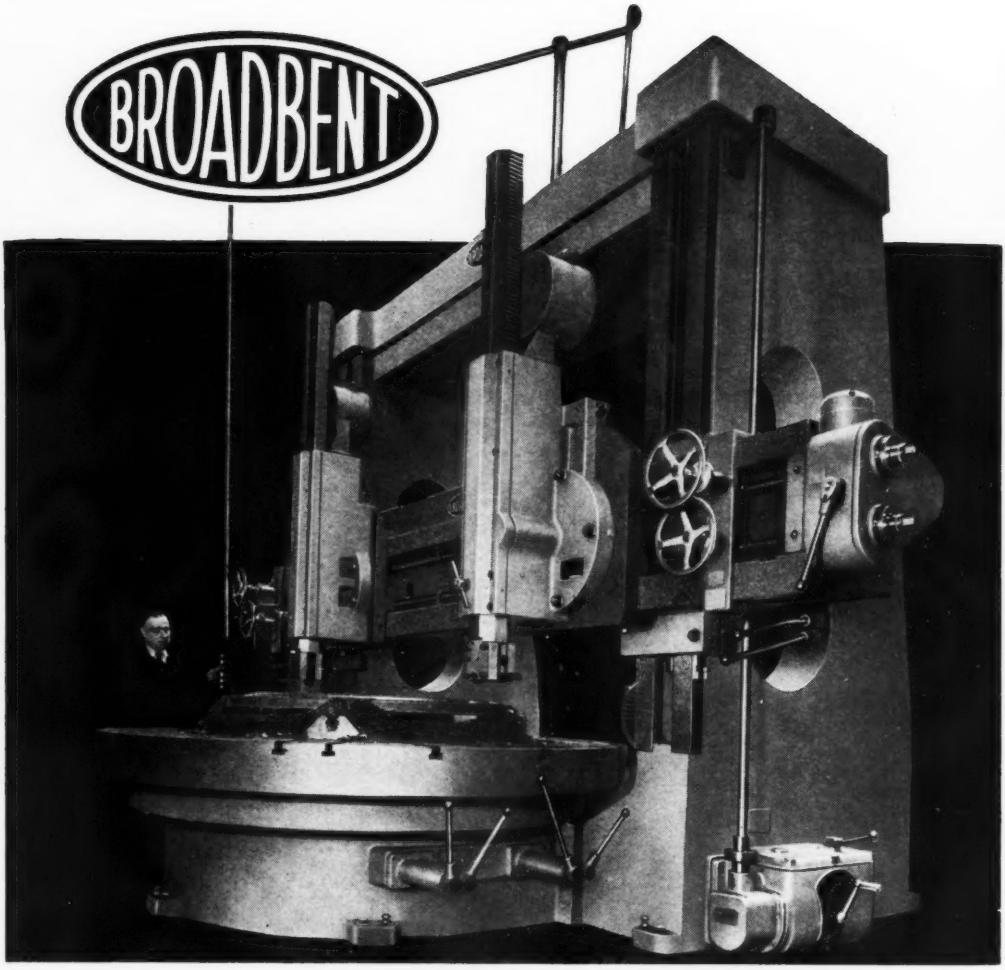
BROADBENT



HEAVY DUTY Vertical BORING & TURNING MILLS

with 5, 6, 8 or 10 ft diameter work tables

These incomparable machines are massively constructed for years of hard service. Accuracy and dependability are of the high order that industry has learned to expect of Broadbent Machine Tools. Notable features of these Boring and Turning Mills include twelve changes of speed and six changes of feed, controllable from either side of the machine; spiral bevel and spur reduction gears driving the work table; pendant control of rams and cross slides; and rapid power traverse with independent control of the two heads.

Please write for fully illustrated brochure.

BROADBENT

manufactured within the KERRY GROUP by

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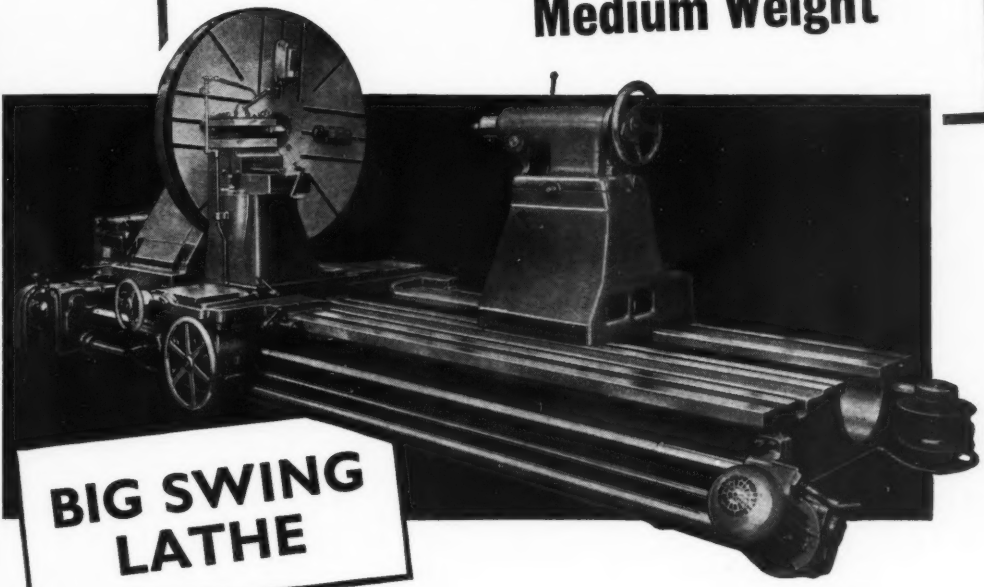
Broadway/HB8

For Turning LARGE Diameter Drums and Rollers of Medium Weight



BIG SWING LATHE

The O & S Range also includes:

SS & SC lathes from 10½ in. to 24 in. capacity; surfacing and boring lathes up to 96 in. swing; break lathes; railway carriage and wagon wheel lathes; axle journal turning and burnishing lathes; straightening presses.

This lathe will swing up to 6 ft. over the saddle and is specially designed for Turning Drums, Rollers, etc. It is easy to handle, economical in operation and competitively priced. The Big Swing also makes this an ideal machine for general maintenance work.

The O & S Big Swing Lathe incorporates all these features:

- Up to 6 ft. swing over saddle
- Up to 25 ft. between centres
- 12 spindle speeds
- Large hollow spindle
- Spindle bearings PB or Taper Roller
- 32 enclosed change feed and screw-cutting box
- Long lead cutting gear
- Quick power motion to saddle
- Power feed to compound top slide if required
- Power feed to loose headstock if required
- 30 or 35 H.P. motor drive

O & S

manufactured within the KERRY GROUP by
OLDFIELD & SCHOFIELD CO. LTD
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SAWMASTER

TYPE 10B AUTOCUT

HEAVY-DUTY

BANDSAW

For higher production

Infinitely variable cutting speeds, accurate blade guidance, faster cutting times, power lifting and lowering of sawframe, simplicity of operation and of blade changing mean higher production than with any comparable saw. The completely automatic cutting cycle facilitates repetition work.

the British made Bandsaw that is in the world's top class

—and the famous SAWMASTER Power Hacksaws 6" 8" 10" or 12" capacity

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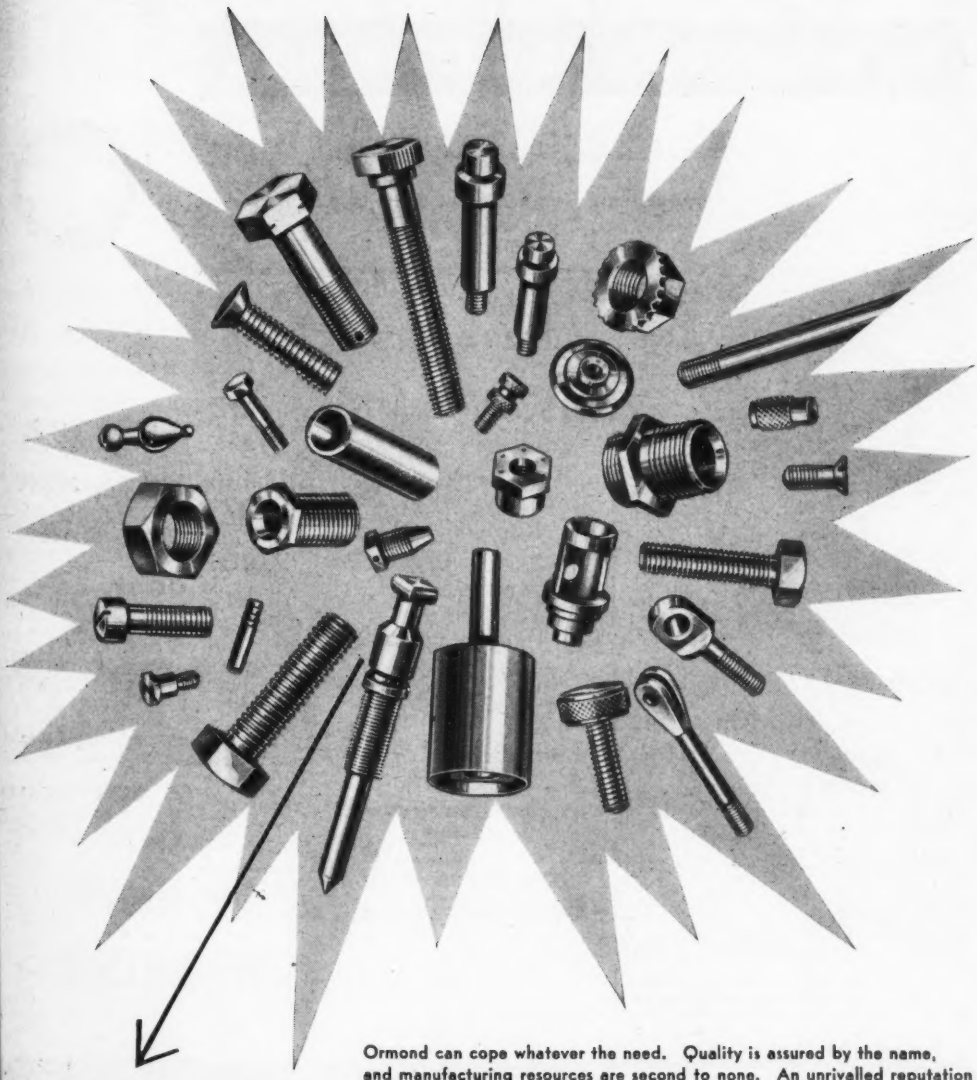

Repetition work

Ormond can cope whatever the need. Quality is assured by the name, and manufacturing resources are second to none. An unrivalled reputation for service takes care of prompt delivery. Please ask us to quote. Any quantity.

The Repetition Parts range covers single and multi spindle automatics up to 1¼" dia., Brass, Steel and Light Alloy Screws in Rolled and Cut Threads, Grubscrews, Nuts, Allthreads, Hexagon Bolts and Setscrews turned from bar and Cold Headed Grades "A", "B", and High Tensile.

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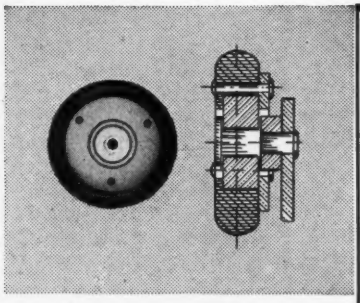
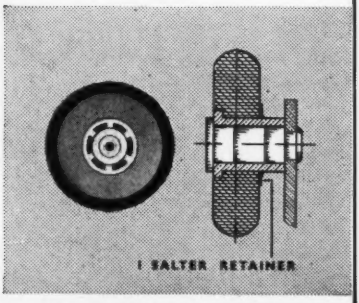
D

How costs are cut with SALTER RETAINERS

Salter retainers simplify design of overhead door wheel with great savings



THE OLD WAY Overhead door wheel flushing held in wheel by three rivets. Difficult to position rivet holes and many rejects. Rivets would work loose in use.



THE SALTER WAY A Salter Self-locking Retainer which requires no groove, replaces three rivets, a spacer and three press operations. Cuts cost and manufacturing time and gives a better and cheaper product.

ELIMINATES	
drilling 3 rivet holes	·18
riveting washer	·5
punching washer	·02
washer, spacer, rivets	·95
CUTS COST OF	
inserting bushing	·01
inspection	·14
wheel, bushing, rivet	3·45
TOTAL SAVING WITH SALTER RETAINERS	5·25d

*

1 SALTER RETAINER cuts unit cost by 44% and eliminates 3 operations and 5 parts

NEATER – MORE POSITIVE – PERMANENT RETAINING

SALTER "TRUARC"

Circlips Fasteners Retainers Fixes

Geo. Salter & Co. Ltd., West Bromwich. Spring Specialists since 1760

M-W. 483

Fully Automatic Cycle *plus*

crush formed full profile wheels

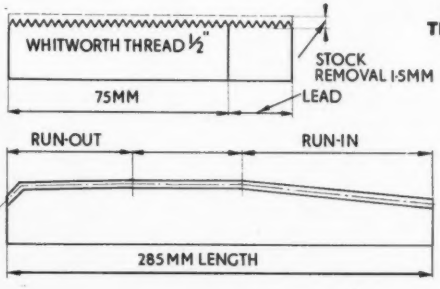
The most advanced machine of its class, the fully automatic Magerle is designed both for surface grinding and high production profile work.

By the Magerle method, crush formed work is now produced as easily as surface grinding. Let us send you full particulars on this versatile, high precision machine.

MÄGERLE

PRODUCTION PROFILE GRINDER

- **Constant peripheral wheel speed.**
- **Auto compensation for wheel wear through dressing.**
- **Auto-sizing within 0·0002in.**
- **Table sizes from 29½in. by 9 7/16in. to 49¼in. by 9 7/16in.**



GRINDING OF THREAD ROLLING DIES

GRINDING TIME floor to floor 16 minutes

ACCURACY OF FORM 0·005mm

GASTON E. MARBAIX LTD.

NRP. 3423C

DEVONSHIRE HOUSE, VICARAGE CRESCENT, BATTERSEA, LONDON, S.W.11 **Phone: BATtersea 8888 (8 lines)**

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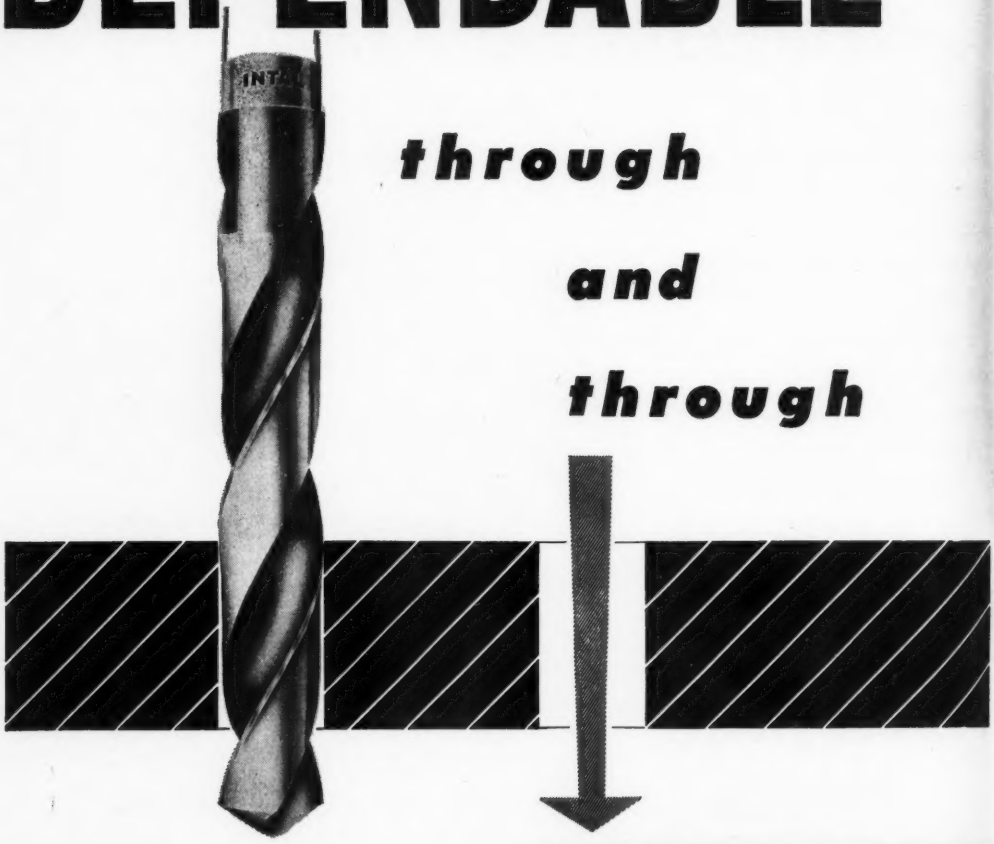

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TWIST DRILLS

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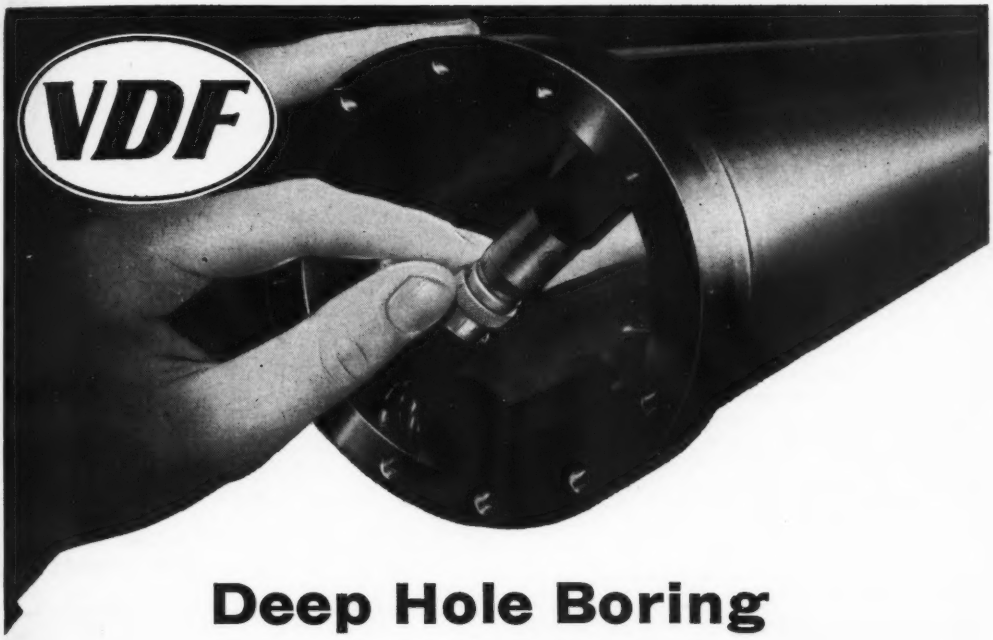
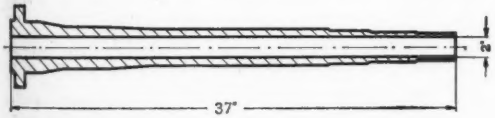
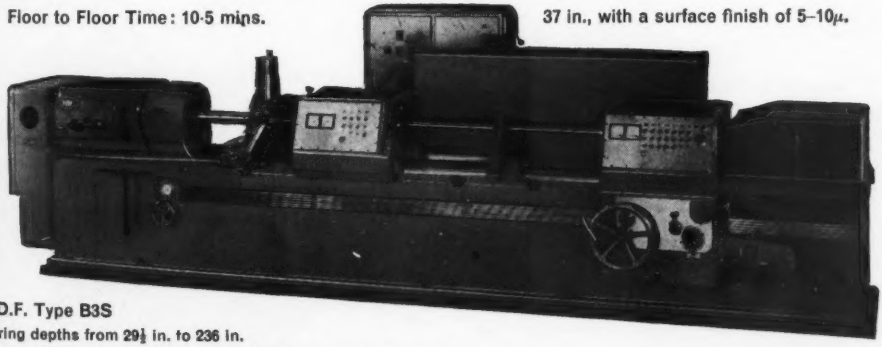


Deep Hole Boring



- Spindle Speed: 710 R.P.M.
- Feed Rate: ·0063 in./rev. ■ Material: EN 9.
- Floor to Floor Time: 10·5 mins.

The work spindle illustrated is machined on a V.D.F. Deep Hole Boring Machine using the solid boring method and central chip disposal. The maximum axial deviation is ·0039 in. over the length of 37 in., with a surface finish of 5–10μ.



V.D.F. Type B3S
Boring depths from 29½ in. to 236 in.
Other models up to a maximum boring depth of 40 ft. and 16 in. dia.

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SYKES MACHINE TOOL COMPANY LIMITED

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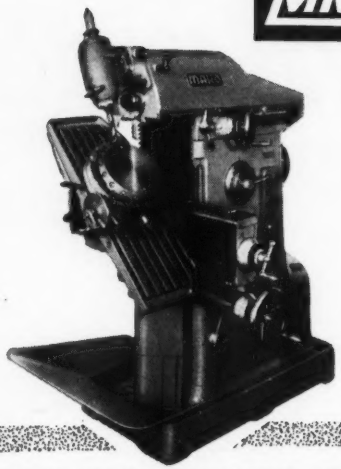
MAHO

THE MOST COMPLETE RANGE OF UNIVERSAL JIG MILLING AND DIESINKING MACHINES

These Four Universal Tool Milling and Diesinking Machines cover the requirements of all toolrooms large and small. Absolute versatility is provided by unique construction and extremely wide range of auxiliary equipment, including optical co-ordinate setting for jig boring. This range enables tools to be machined up to approximately one ton in weight.

MMT



CHECK YOUR TOOLROOM REQUIREMENTS AGAINST THESE MODELS

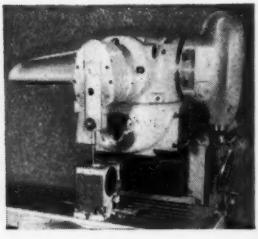
MAHO MH.600. Table 24" x 8¼", horizontal spindle speed 55 - 1000 r.p.m., vertical spindle speed 99 - 1650 r.p.m.

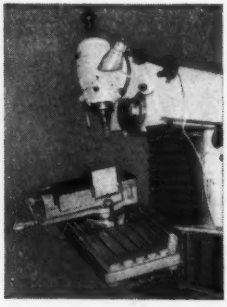
MAHO MH.700. Table 27½" x 10¼", horizontal spindle speed 65 - 1000 r.p.m., vertical spindle speed 99 - 1650 r.p.m.

MAHO MH.800. Table 31½" x 12½", horizontal spindle speed 32 - 1320 r.p.m., vertical spindle speed 45 - 1900 r.p.m.

MAHO MH.1000. Table 47¼" x 14½", horizontal spindle speed 40 - 2000 r.p.m., vertical spindle speed 40 - 2000 r.p.m.

Models MH.800 and MH.1000 are equipped with independent spindle drive motors mounted on ram.

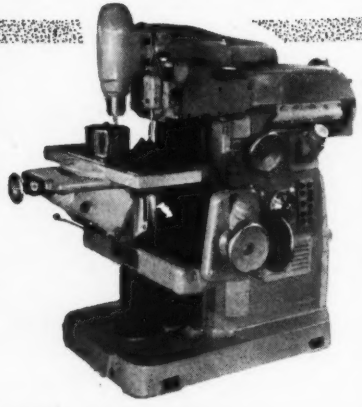




OPTIONAL EXTRA ACCESSORIES INCLUDE . . .

Vertical milling head, slotting attachment, high speed vertical milling head, rotary table, fixed swivelling and tilting, and swivelling tilting and inclinable tables, punch milling attachment, dividing head and spiral milling attachment, and on the larger models power fed vertical milling attachment will be available. It is also possible on the MAHO model MH.800 to fit this machine with hydraulic copying equipment, and on the model MH.1000 HEID electronic copying equipment is available.

Optical readers and rules can be supplied for the headstock slide, longitudinal traverse slide and vertical traverse slide.



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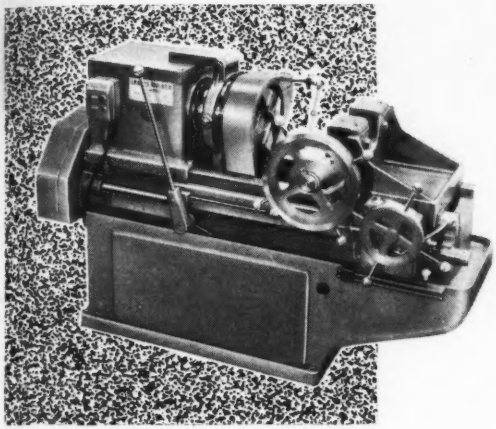
EXCLUSIVE DISTRIBUTORS OF THE FINEST MACHINE TO

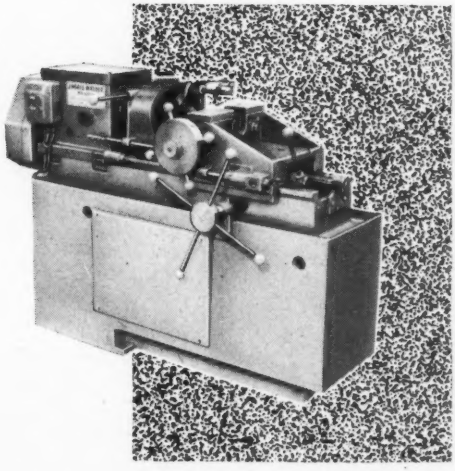
NRP 5083



LANDIS-MAIDEN
'MB' THREADING MACHINES

are designed and built on a unit construction basis, enabling standard machines to be modified to meet customers' individual requirements.

– for rapid threading of bolts and tubes



Two types, four sizes, for threading bolts from ¼″ to 3″ and tubes from ⅛″ to 4″. 8 or 12 spindle speeds, according to type. Landis-type carriage front is adjustable in both the vertical and horizontal direction for accurate work alignment. Saddle traversed either by rack and pinion or leadscrew control. Hammer blow-vice eliminates operator fatigue.
Genuine Landis Diehead with Landis Ground-thread Chasers (made in England) are fitted. Automatic opening ensures predetermined length of thread.

ALFRED HERBERT LTD., COVENTRY Factored Division, Red Lane Works.

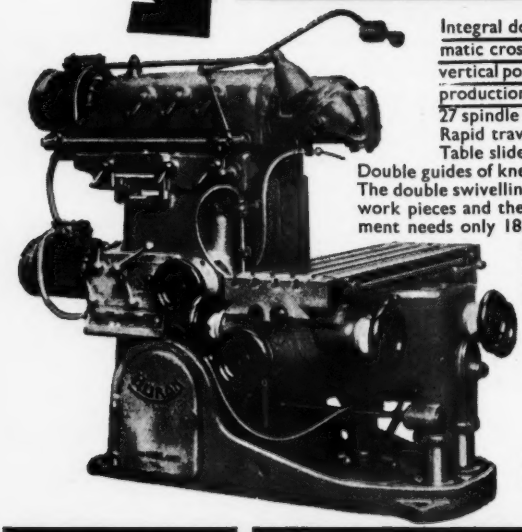
AD650

SLIDING RAM GIVES 27½in. AUTO CROSS FEED

HEAVY DUTY MILLING

ANGULAR COMPOUND HORIZONTAL VERTICAL

HURON SUPER UNIVERSAL MILLERS



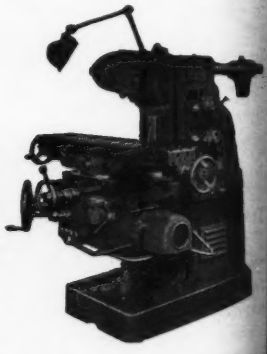
Integral double swivelling universal head provided with 27½in. automatic cross feed by the sliding ram, can be set to the horizontal or vertical position, or to any angle instantaneously—permits the heaviest production cuts. Head can be retracted completely from table line. 27 spindle speeds from 30 to 2,066 r.p.m., 27 feeds from $\frac{1}{16}$in. to 30in. Rapid traverses in all directions. All operating controls duplicated. Table slides directly in the knee without cross movement or swivel. Double guides of knee permit components in excess of 1½ tons to be machined. The double swivelling universal head requires an opening of only 14in. to enter work pieces and the whole sliding ram with its 27½in. automatic cross movement needs only 18in. clearance. OPTIONAL EXTRA FEATURES: Mounted spacing casting assemblies providing additional 8in. capacity under spindle. 26in. wide 8 T-slot tables and 39⅜in. automatic cross feed of sliding ram with special heavy duty knee and front operating position.

Type	Table	Automatic Feeds Long	Cross	Vert.
KU4	56½in. × 15⅝in.	43½in.	27½in.	19½in.
KU5	64½in. × 15⅝in.	51½in.	27½in.	19½in.
KU6	78⅝in. × 16½in.	59in.	27½in.	19½in.
KU55	64½in. × 26in.	51½in.	38⅜in.	18½in.
L83	157in. × 59in.	118in.	39⅜in.	59in.

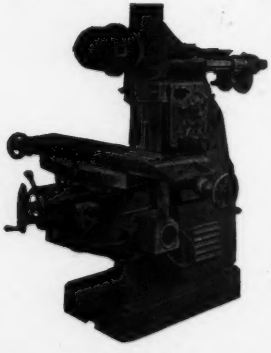
Type 'L' Open-side Traversing Head Universal Miller will mill, bore, slot and drill the largest work-pieces at one setting. The unique design permits greatest variety of operation on large work-pieces; the component remains stationary on the large work-table. Upright slides full length of base table and the sliding ram moves vertically and horizontally.

DUFOUR UNIVERSAL MILLERS

WITH DOUBLE UNIVERSAL SWIVELLING HEAD, RETRACTABLE SLIDE BRACKET AND SPACING CASTING GIVING 26" DAYLIGHT ON No. 59 AND 21" ON No. 61



FOR ALL MODELS Direct reading dial change for speeds and feeds. All parts subject to wear hardened and ground and completely interchangeable. Built to closest tolerances. Rapid traverses in all directions. Table swivels 30°. No. 40 taper for main horizontal spindle, double swivelling universal head, dividing head and rotary table. Hardened and ground centre guide for slideways. Twin overarms. Double swivelling sliding spindle heads with speeds 53-3000 r.p.m. Double swivelling universal head on retractable slide bracket providing with 5½in. Spacing Casting Drive assembly on 59 Machine 26in. daylight, and 21in. on No. 61.



MODELS 53 & 61. 16 universal head spindle speeds 21-1600 r.p.m.; 8 horizontal spindle speeds 21-1180 r.p.m.; 8 automatic feeds ½-18½in.

MODEL 59. 36 universal head spindle speeds 14-1780 r.p.m.; 12 horizontal spindle speeds 21-1180 r.p.m.; 16 automatic feeds ½-20in.

MODEL 54. Automatic cross feed of universal head 20in.; 18 universal head spindle speeds 12-1500 r.p.m.; 36 horizontal spindle speeds 6-1500 r.p.m.; 18 automatic feeds $\frac{1}{16}$-23½in.

Type	Table	Automatic Feeds Long.	Cross	Vert.
53	43½in. × 9½in.	27½in.	9½in.	15½in.
61	47½in. × 10½in.	30½in.	9½in.	15½in.
59	51½in. × 11½in.	34½in.	11½in.	21½in.
54	67in. × 14½in.	43½in.	14½in.	20½in.

Send for full particulars of our very extensive range of these machines; ask for demonstration.

Rudolph Carne & Co. Ltd.

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A NEW RANGE OF NEWMAN MOTORS

THE

Newman SEAL

'OPEN' MOTOR

Protected against damage by

WATER

OIL

CHEMICALS and

AIRBORNE ABRASIVES

An 'OPEN' motor for a totally enclosed application..... by

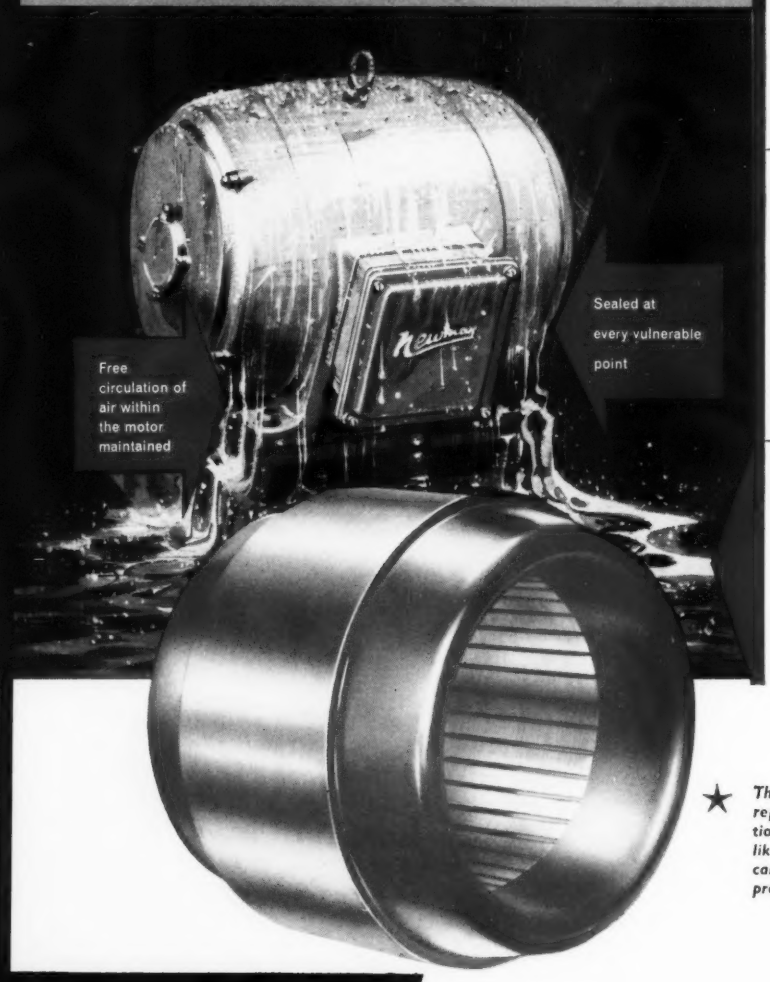
Newman

THE NewmanSEAL 'OPEN' MOTOR

for use in applications where WATER, OIL, CHEMICALS or AIRBORNE ABRASIVES are present.

BETTER THAN TOTALLY ENCLOSED. Tests have proved that for many applications the 'NewmanSEAL' open motor is more satisfactory because an enclosed motor 'breathes' and so can suck in damaging fumes to make contact with the windings. Also the free circulation of air within the 'NewmanSEAL' motor prevents condensation troubles which are not uncommon in totally enclosed motors. ★

SPECIFICATION: Open (ventilated) 3-phase, squirrel-cage, 50 cycles, 650 volts maximum. Temperature rise 65°C, Class 'E' insulated. To BS2613:1957 NEMA Standard Dimensions. Range: ½ to 125 hp.

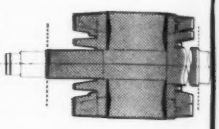


ENCAPSULATED STATOR WINDINGS

The resin, which has excellent dielectric qualities is applied in liquid form and penetrates deep into the windings, as this sectioned view illustrates. Also the stator bore is sprayed with resin to help protect the laminations against corrosion.

RESIN PROTECTED ROTOR

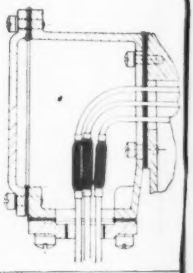
The rotor is sprayed with resin to help protect the 'open' surfaces against corrosion.



SEALED TERMINAL BOX

Wide flanges and the use of gaskets between all joints ensures positive sealing. Also the opening between the terminal box and the inside of the motor is specially sealed.

LOOSE LEADS – The motors have loose leads instead of a terminal block so that joints of the incoming cables can be taped to make damp-proof joints.



This illustration of the stator winding shows how the encapsulation completely covers and protects the coils. The formulation of the resin used gives a hard positive protection against mechanical damage and yet is resilient enough to withstand repeated expansion and contraction of the windings over their normal operating temperature range.

★ *The 'NewmanSEAL' motor is not intended to replace our totally enclosed motors for applications where excessive dirt or solid masses are likely to clog the air gap – for such conditions we can supply an enclosed motor with the added protection of the 'NewmanSEAL' motor.*

Newman

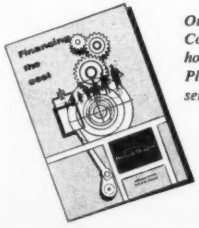
the most progressive name today in electric motor design and manufacture

ELECTRIC MOTORS 1/16 to 600 H.P.

NEWMAN INDUSTRIES LIMITED, YATE, BRISTOL, ENGLAND. Tel. Chipping Sodbury 3311 TELEX 44121

for more profit

As you work out ways and means to boost production, cost is almost certain to rear its head. Yet it's easier than you may think to keep it down, once you have British Wagon Finance working with you. The B.W. Finance Plan allows you to obtain whatever machinery, equipment or plant your plans require—immediately, and out of income. Get in touch with your local British Wagon branch manager. You'll find him very helpful. Our terms are economical, flexible and so simple to arrange.



Our leaflet 'Financing the Cost' gives you full details of how the British Wagon Finance Plan can help you. Let us send you a copy.

THE **British Wagon** COMPANY LIMITED

Head Office:
Moorgate, Rotherham, Yorks. Tel. Rotherham 5466
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BW/M/98C

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16 COPYING METHODS ON THE MAS DIE SINKING MACHINE

solve the problem of economical production of precision moulds, dies and tools. The illustration shows the machine with a vertical attachment using two rotary tables. Also available are two horizontal spindles enabling the simultaneous production of two components.

MODEL FkO8C

IMMEDIATE DELIVERY

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AUTOMATIC
TURRET DRILLING HEAD

CONVERTS SINGLE SPINDLE DRILLS INTO HIGH PRODUCTION MULTI-OPERATION MACHINES

- Performs drilling, reaming, countersinking, counterboring, tapping, etc., in AUTOMATIC sequence
- 4, 5 or 6 Stations
- Only the tool in actual operation rotates
- Easily fitted to most makes of vertical drill

THREE SIZES:

Model B8..... $\frac{5}{16}$"
Model B15 ..... $\frac{9}{16}$"
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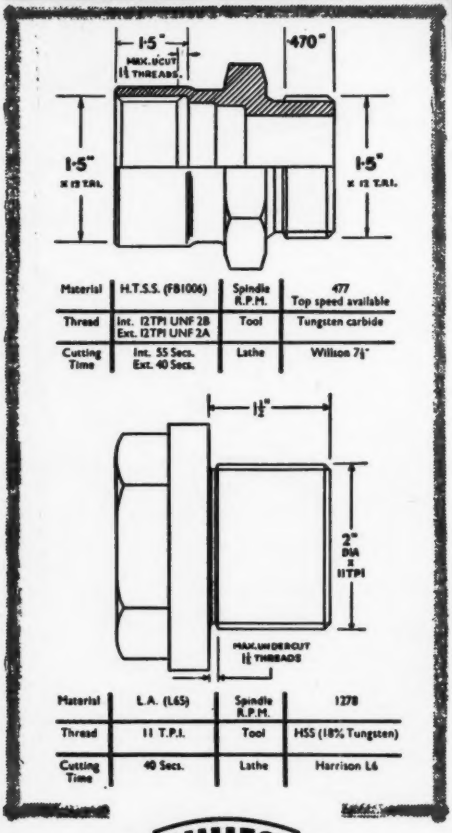
Revolutionary CENTRE LATHE SCREWCUTTING


1·5"
MAX. UNDERCUT 1½ THREADS.
·470"
1·5"
X 12 T.P.I.
1·5"
X 12 T.P.I.
Material | H.T.S.S. (FB1006) | Spindle R.P.M. | 477 Top speed available
Thread | Int. 12TPI UNF 2B Ext. 12TPI UNF 2A | Tool | Tungsten carbide
Cutting Time | Int. 55 Secs. Ext. 40 Secs. | Lathe | Willison 7¼"
1½"
2" DIA x 11TPI
MAX. UNDERCUT 1½ THREADS
Material | L.A. (L65) | Spindle R.P.M. | 1278
Thread | 11 T.P.I. | Tool | HSS (18% Tungsten)
Cutting Time | 40 Secs. | Lathe | Harrison L6

In the same way that the chasing dial has superseded the old method of marking chuck, headstock, leadscrew collar and bracket, the AINJEST HIGH SPEED SCREW-CUTTING ATTACHMENT has established a further major advance in screwcutting techniques. Its use on standard centre lathes allows the automatic engagement and disengagement of the leadscrew at the highest spindle speeds of which the machine is capable.

- ★ The cut cannot be started at the wrong point.
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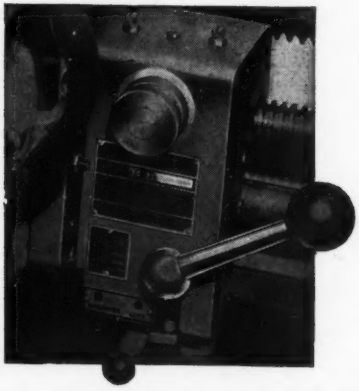
- ★ Tungsten carbide tools can be used with great advantage.
- ★ Chasing dial is eliminated.
- ★ The attachment remains in position, ready for use without restricting the versatility of the lathe.



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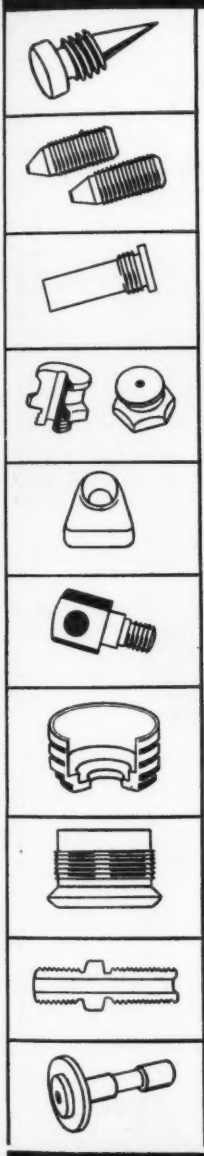

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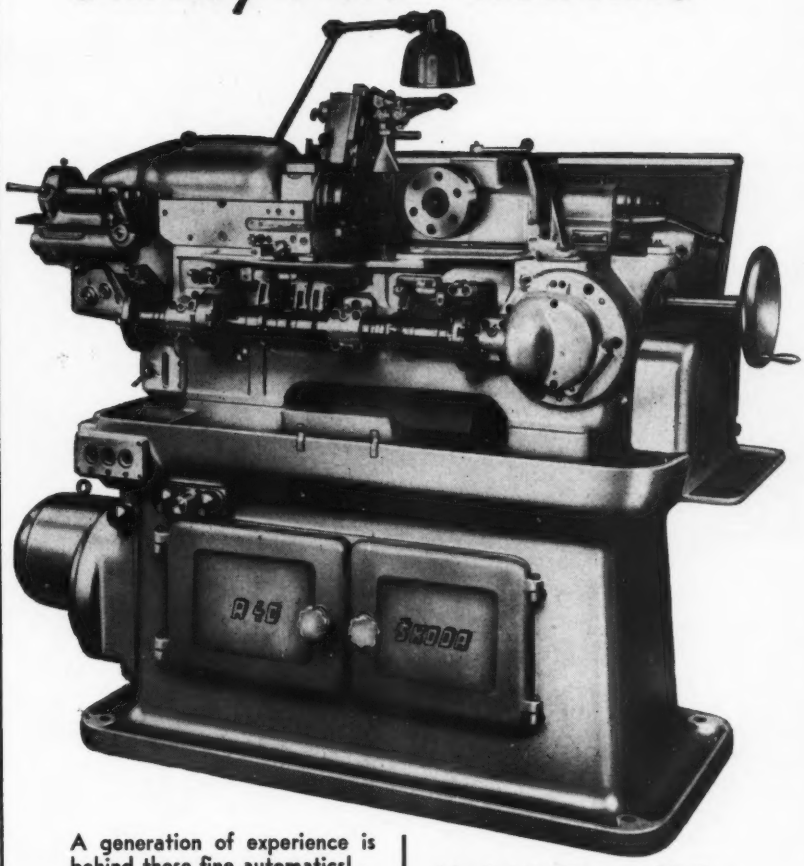

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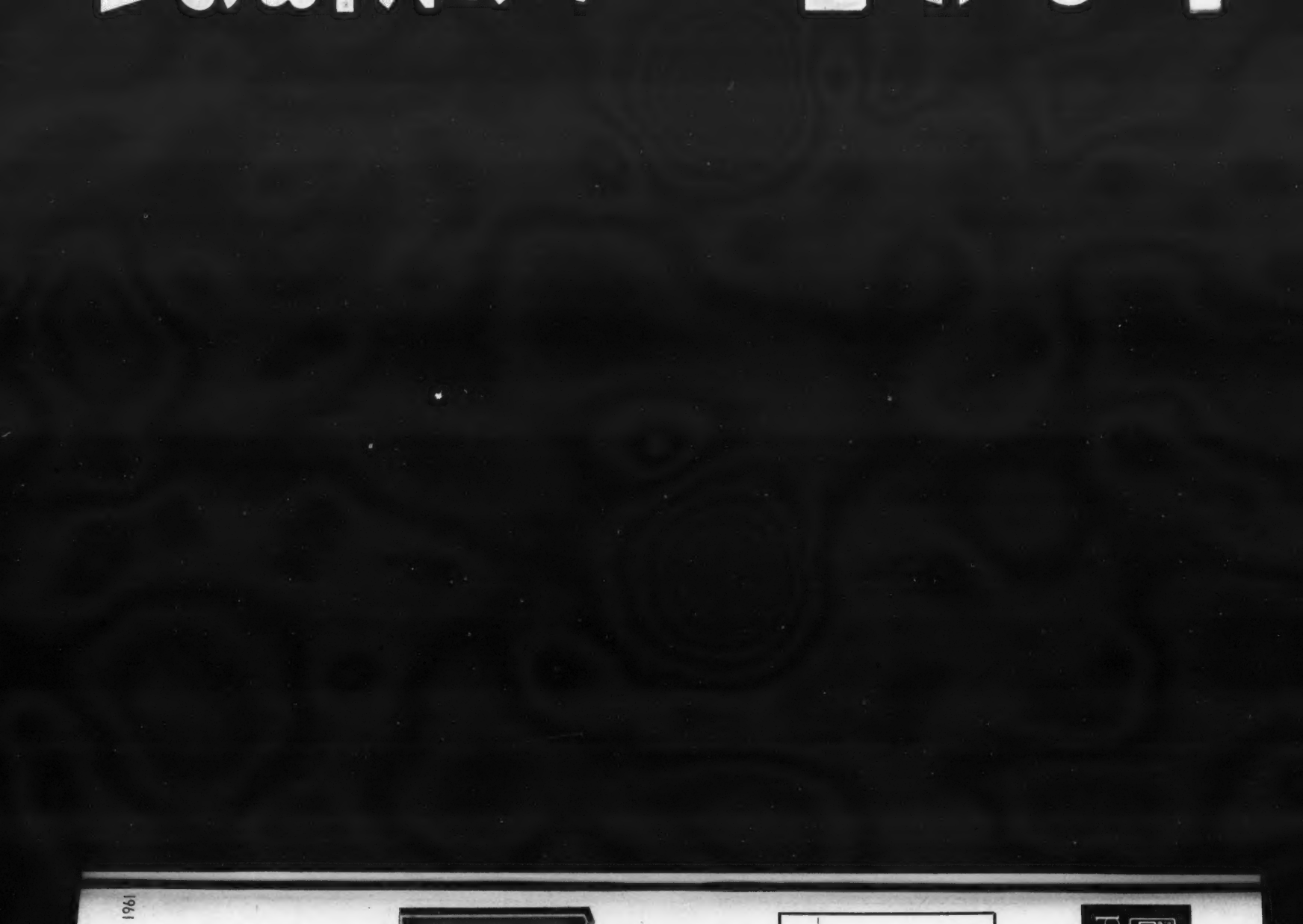
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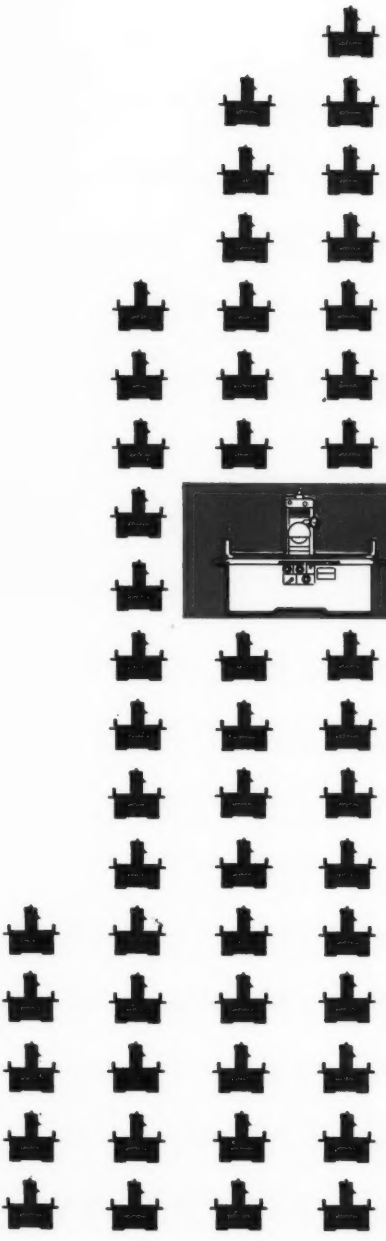

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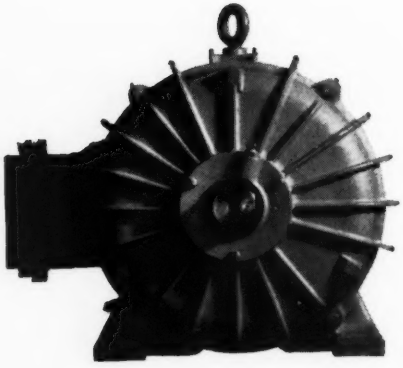

Engineers use the word performance in two senses, a limited one which refers to parameters that can be specified and checked; and a wider, vaguer, but essentially more realistic sense which covers freedom from trouble, ease of servicing, adaptability and many other things. Performance in the first sense is reproducible by any competent manufacturer; it depends on designing to well established principles. Performance in the second sense is the basis of choice between manufacturers. It comes from countless small differences in design that are based on know-how or experience.

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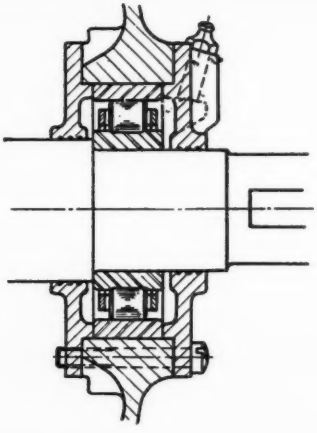

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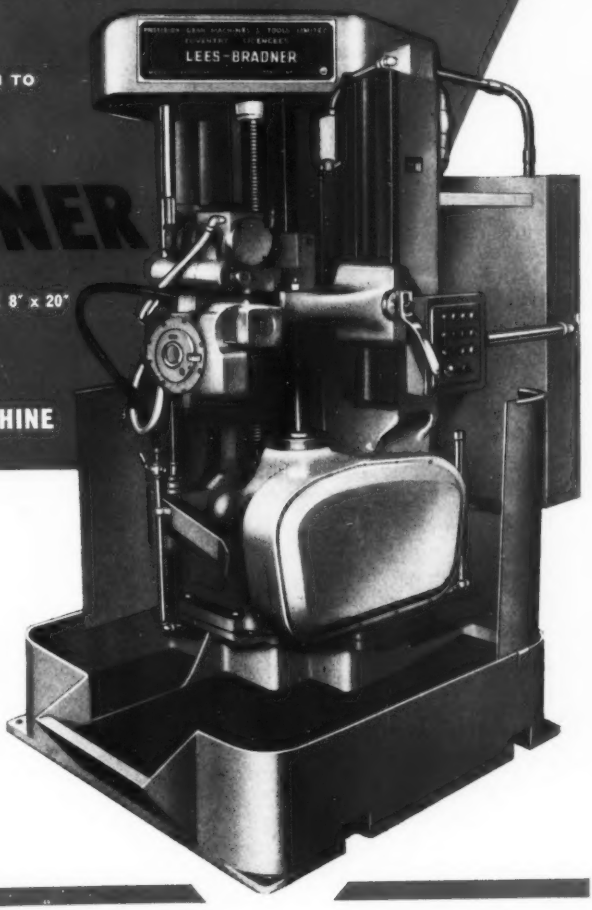

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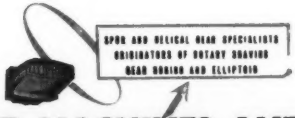

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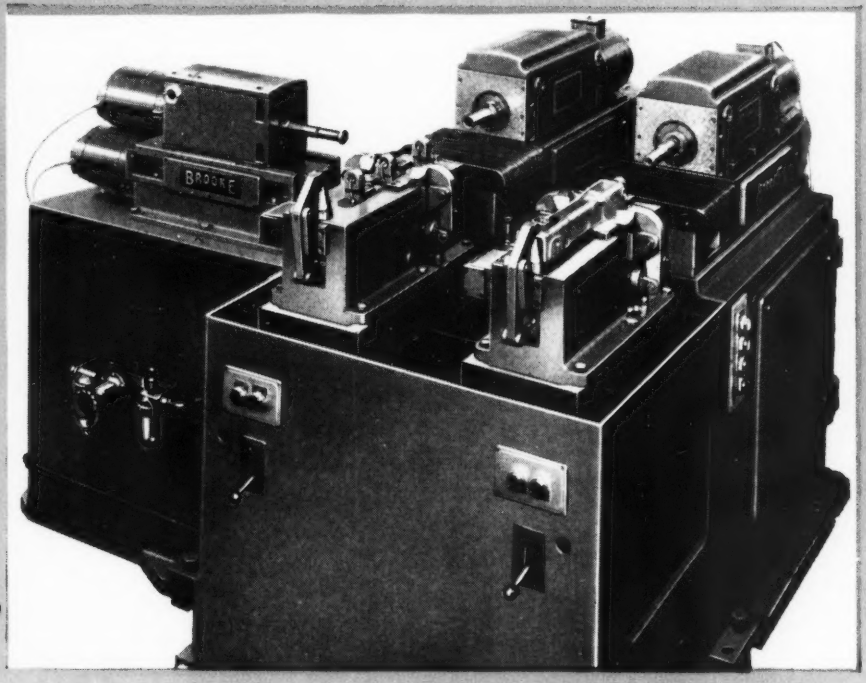
Illustrated is a Three Unit Drilling and Line Reaming Machine for processing gear box top cover components. The operations are the drilling of the longitudinal shaft hole through bushes utilising a jump gap cycle, the reaming of the same hole and the tapping of one hole in the side of the component. The main structure of the machine is a fabricated plate steel base to which one UHO and two UH1 BROOKE UNIT HEADS and two Fixtures are mounted. The Fixtures are easily loaded and clamping is effected by pneumatic means, all controls being readily available for ease of operation. The machine base houses the electrical control equipment, the coolant sump and the pump of suitable capacity.



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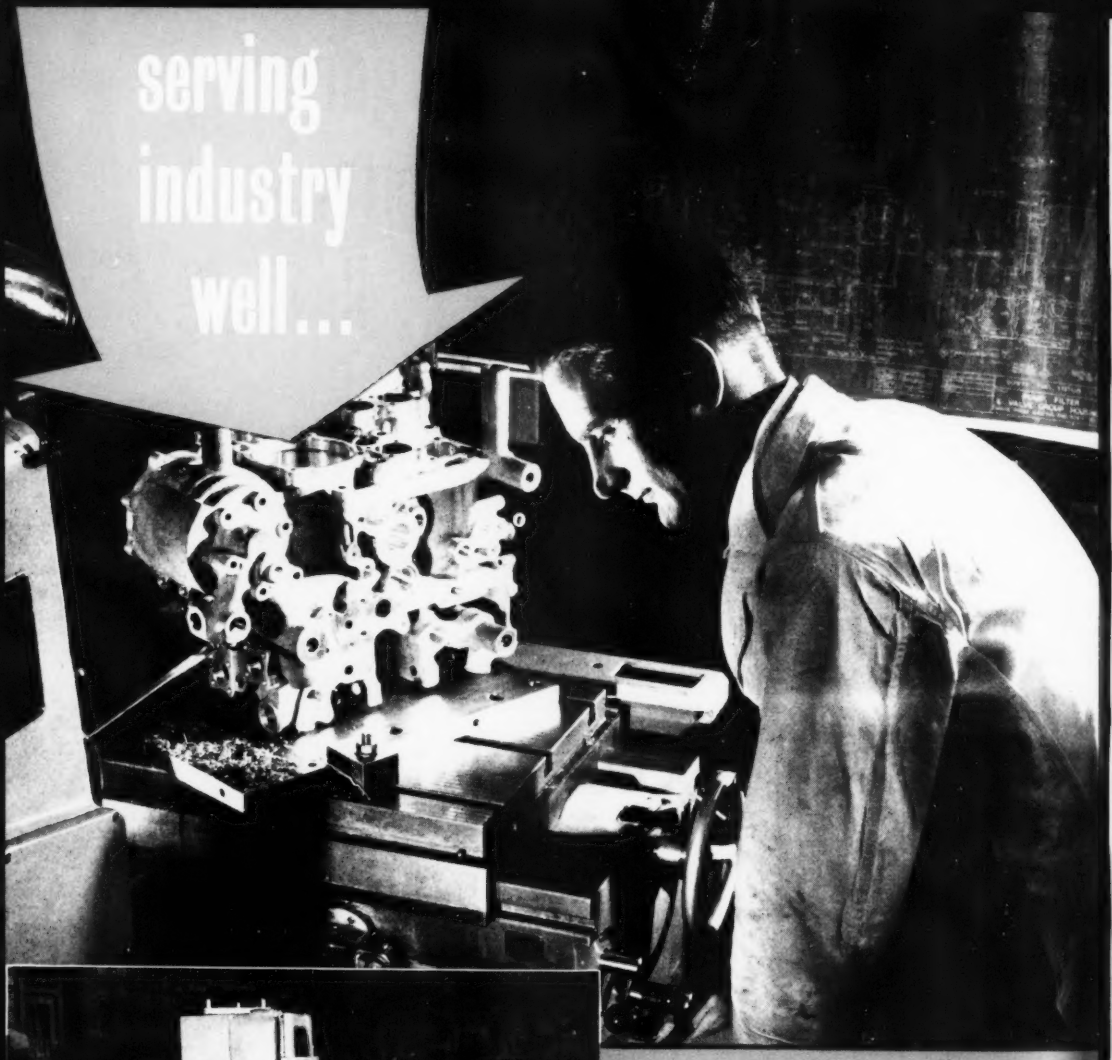

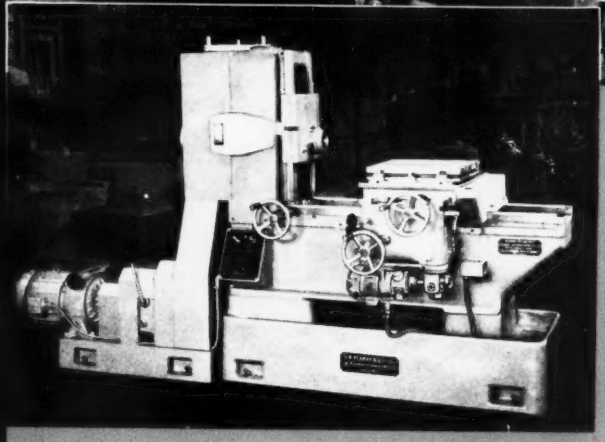

Photo courtesy: "Engine

A Kearns "S" type *OPTIMETRIC Horizontal Tool-Room Boring Machine machining the main body of an aircraft gas turbine fuel control unit at Dowty Fuel Systems Limited.

The casting being machined has...

60 main bores to fine limits
20 recess chambers in the main bores
120 drilled and tapped holes

Left: Recently supplied to Dowty Fuel Systems Limited, a Kearns "S" type *OPTIMETRIC Horizontal Tool-room Boring Machine, High-Speed, Spindle Model.

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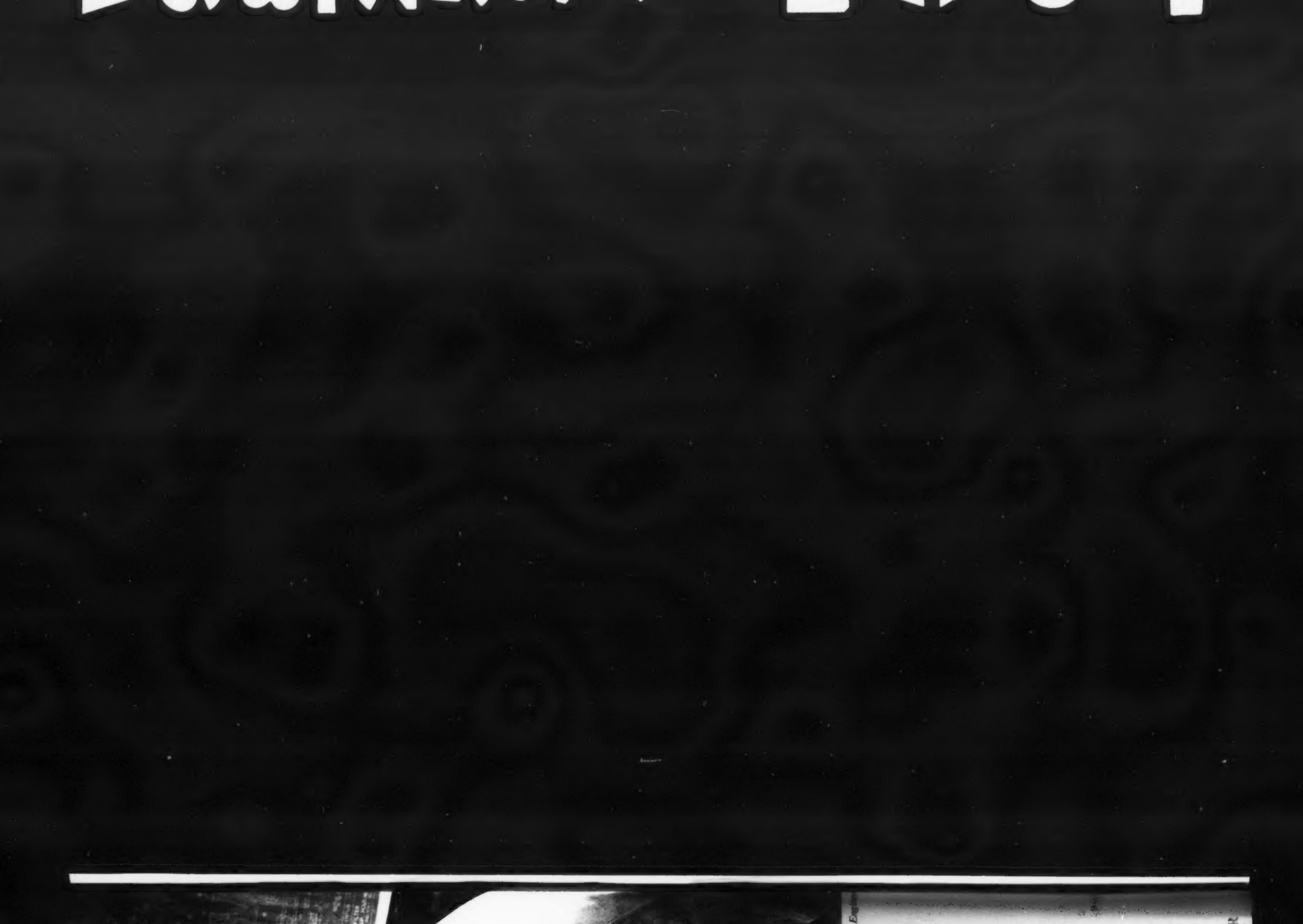

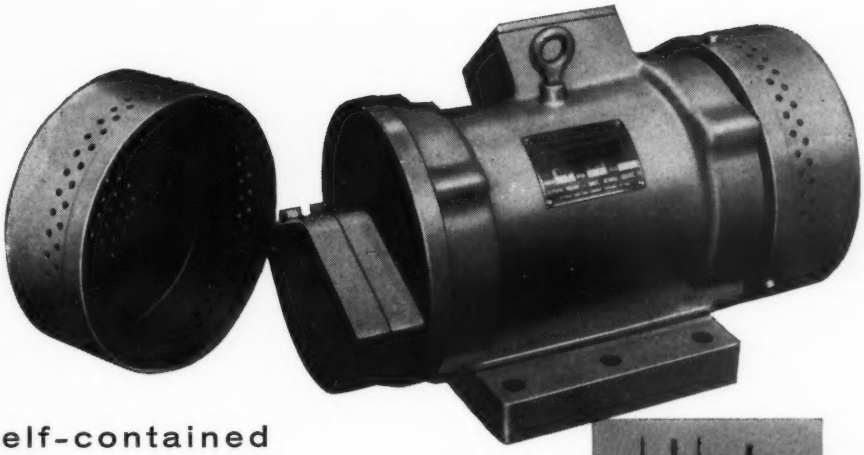

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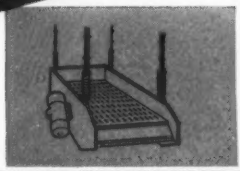

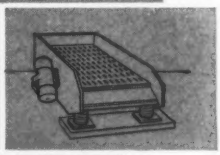

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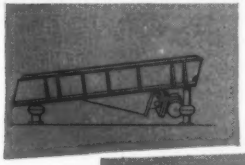

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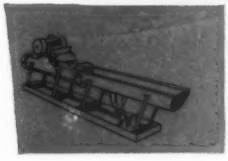

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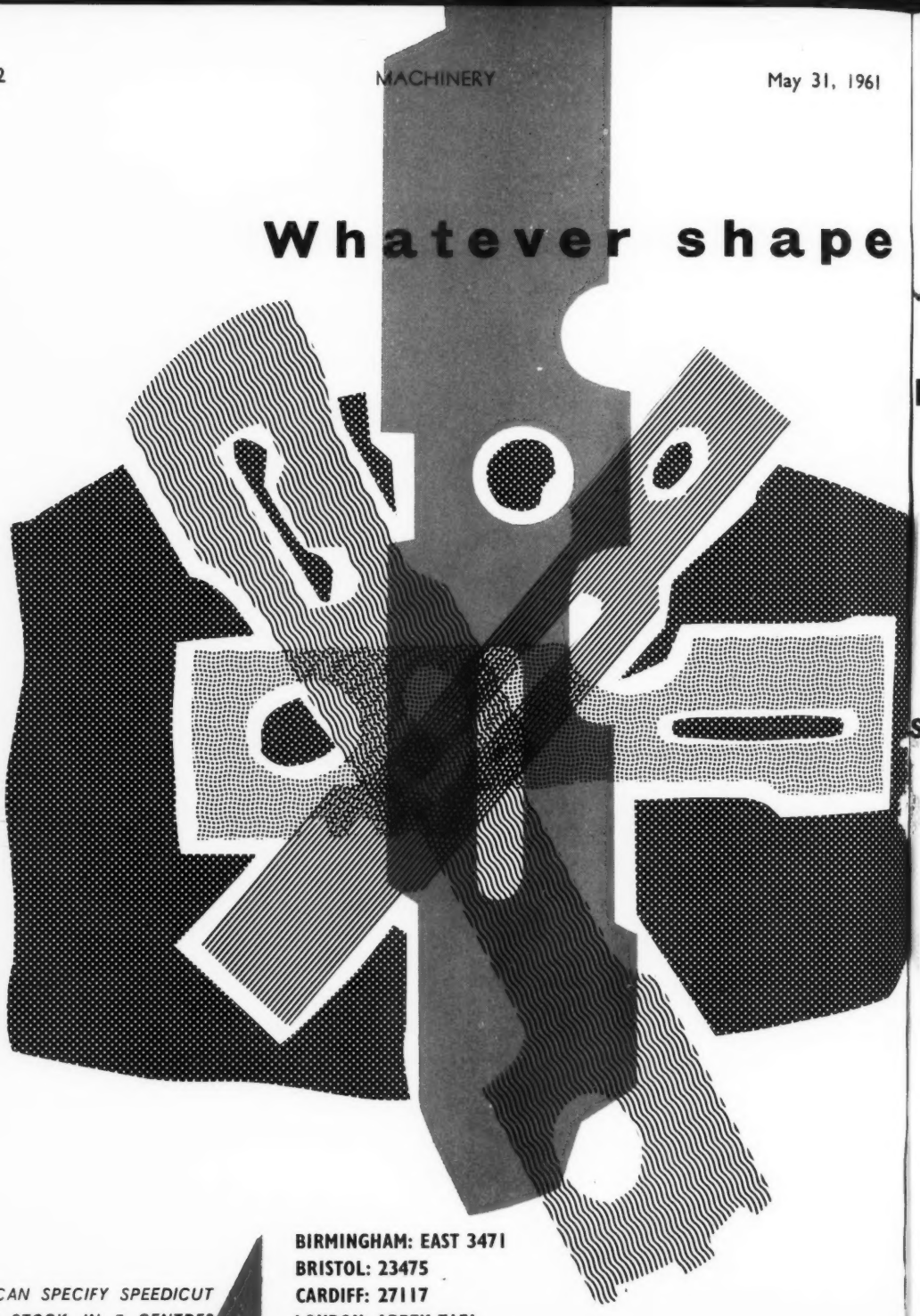

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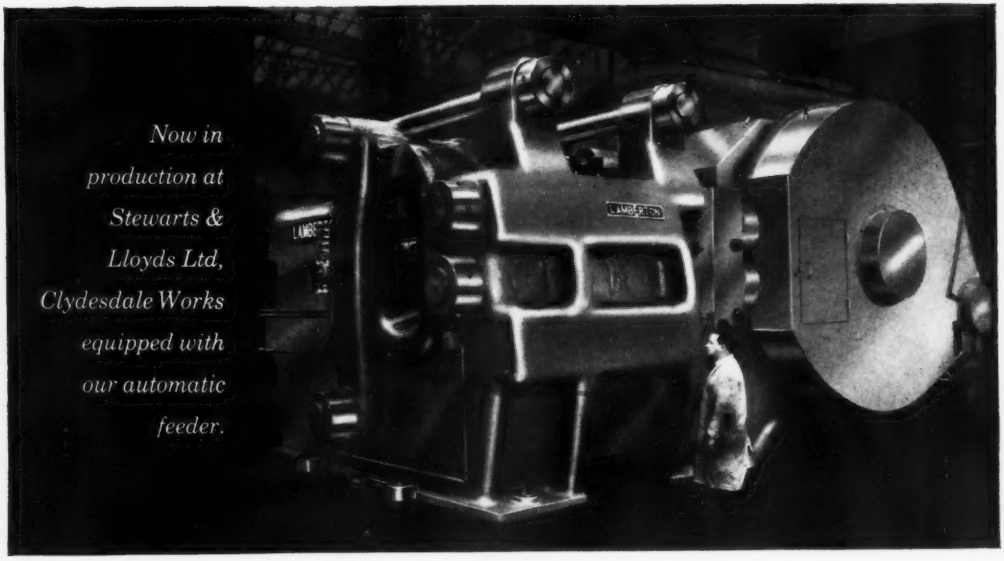

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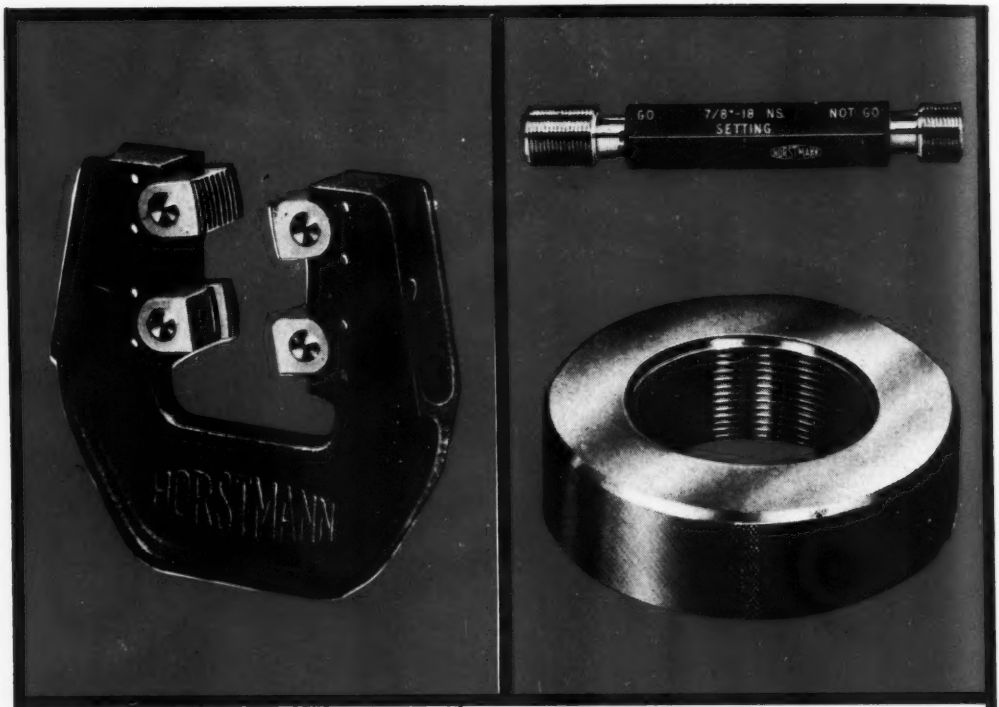

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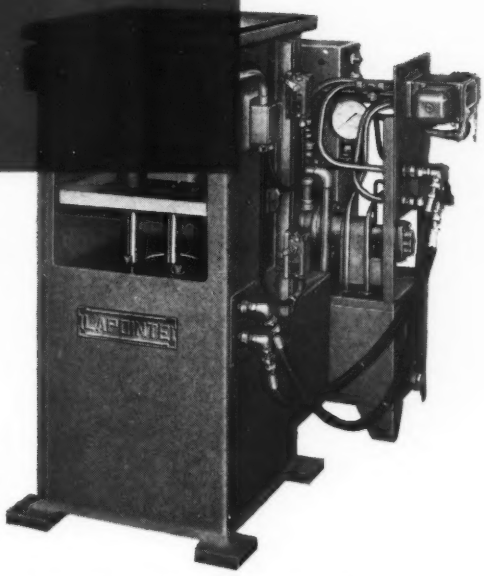

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SPD 7/16 Pull-Down Broaching Machine
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Stroke: 16 in.
Cutting speed: 5-15 ft/min. variable.

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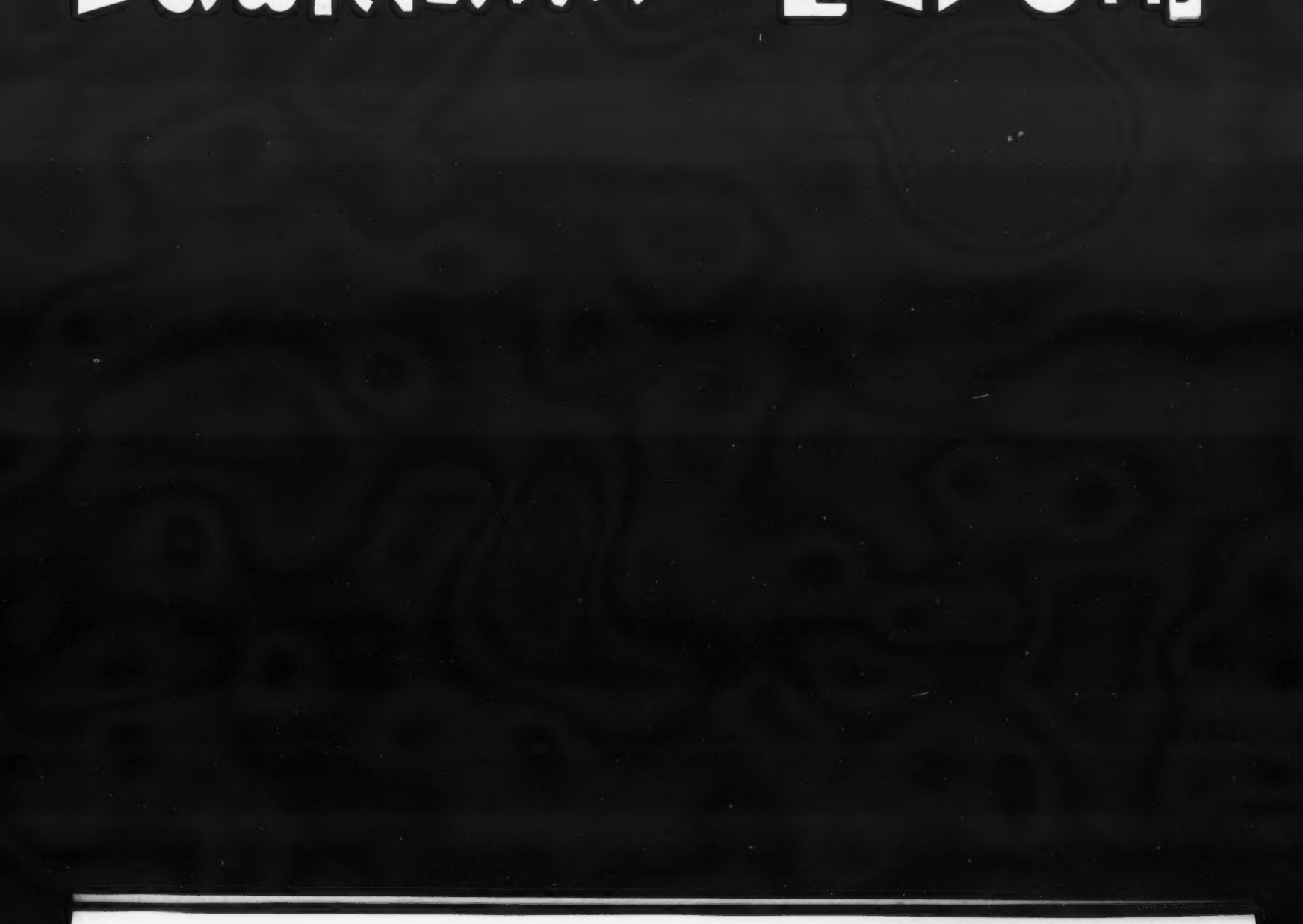

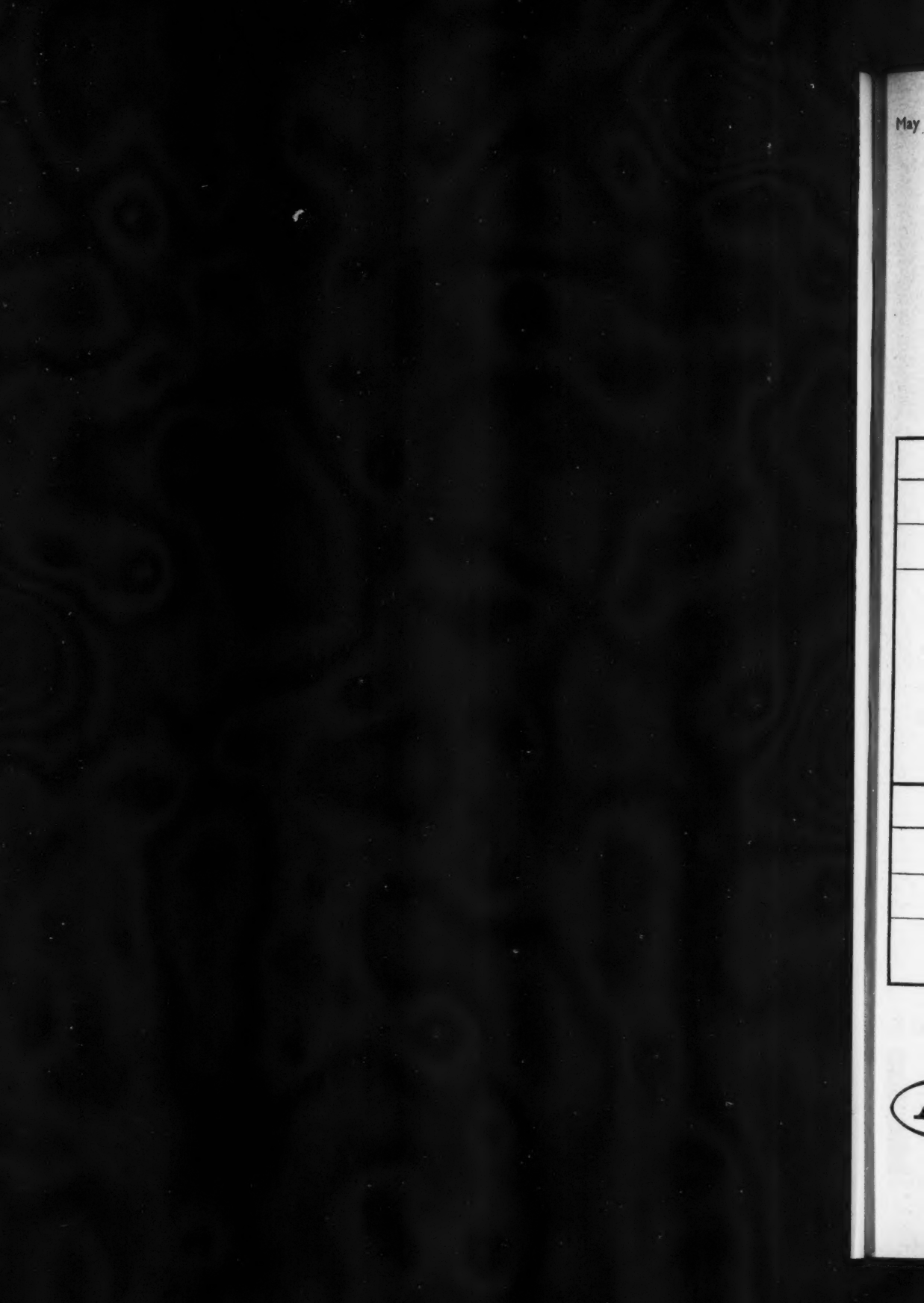
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70	720	50	730
*75	970	†65	1475
100	1455	†65	975
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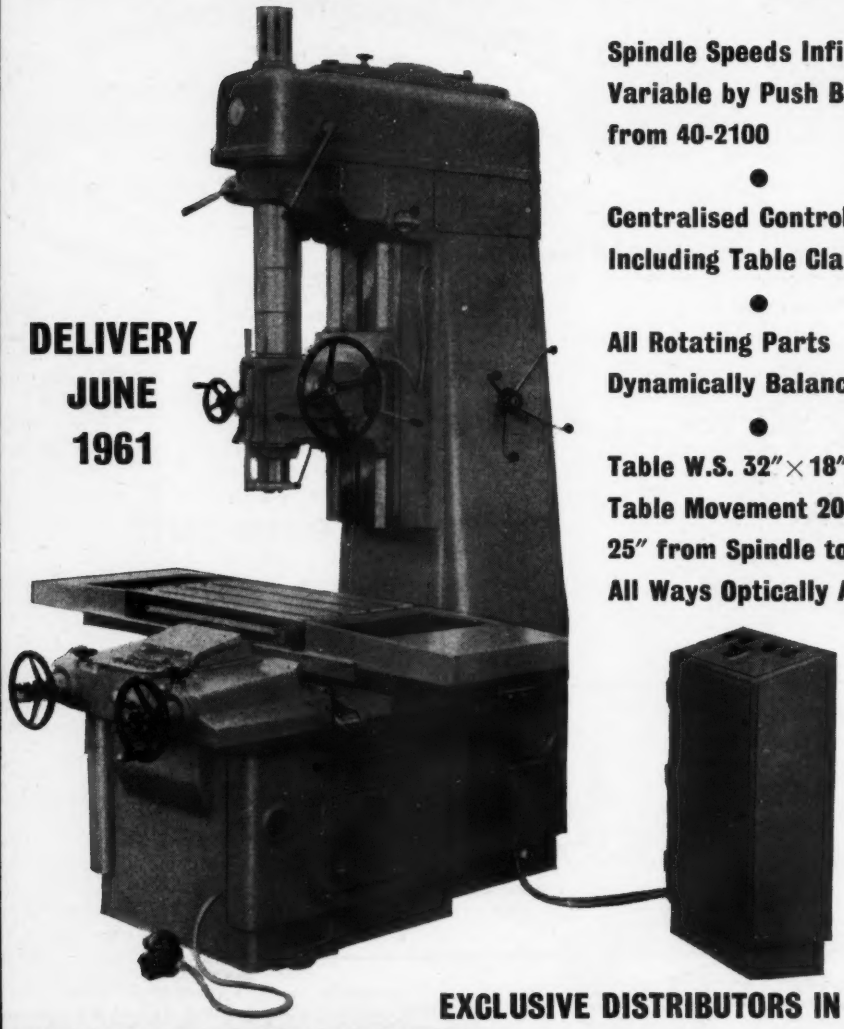

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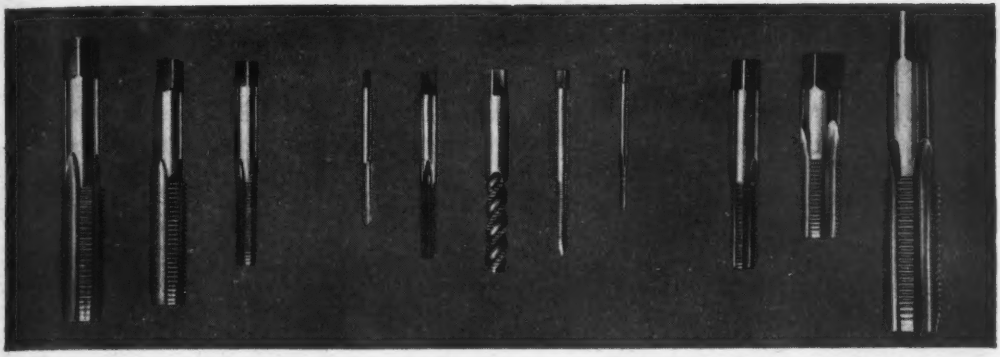

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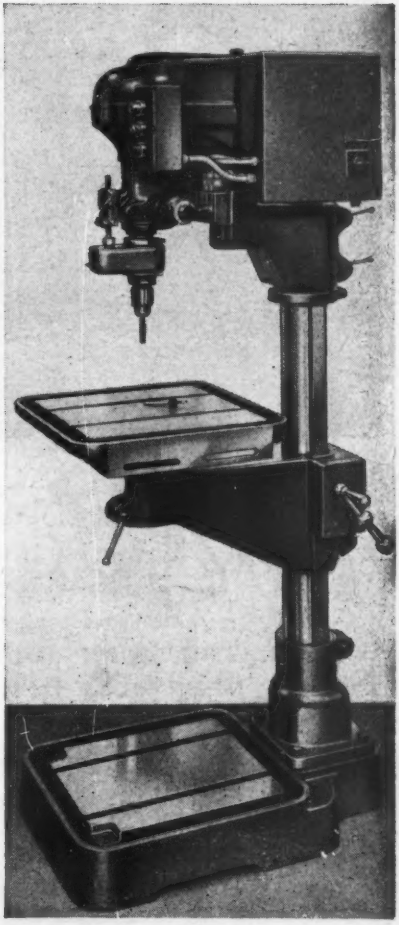

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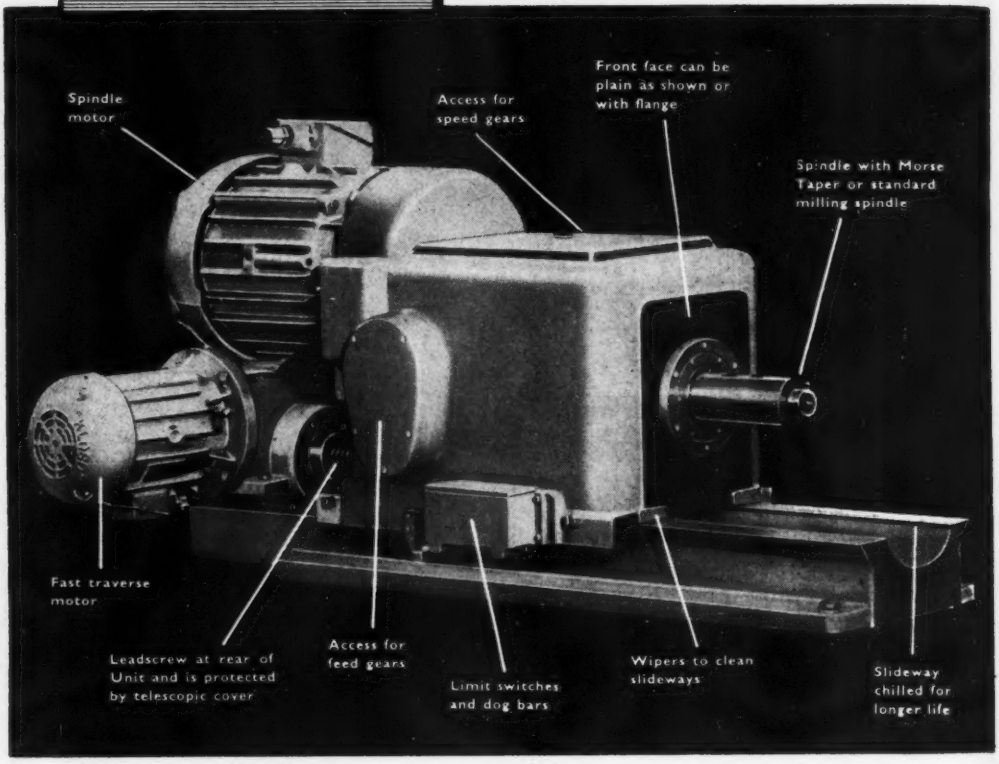
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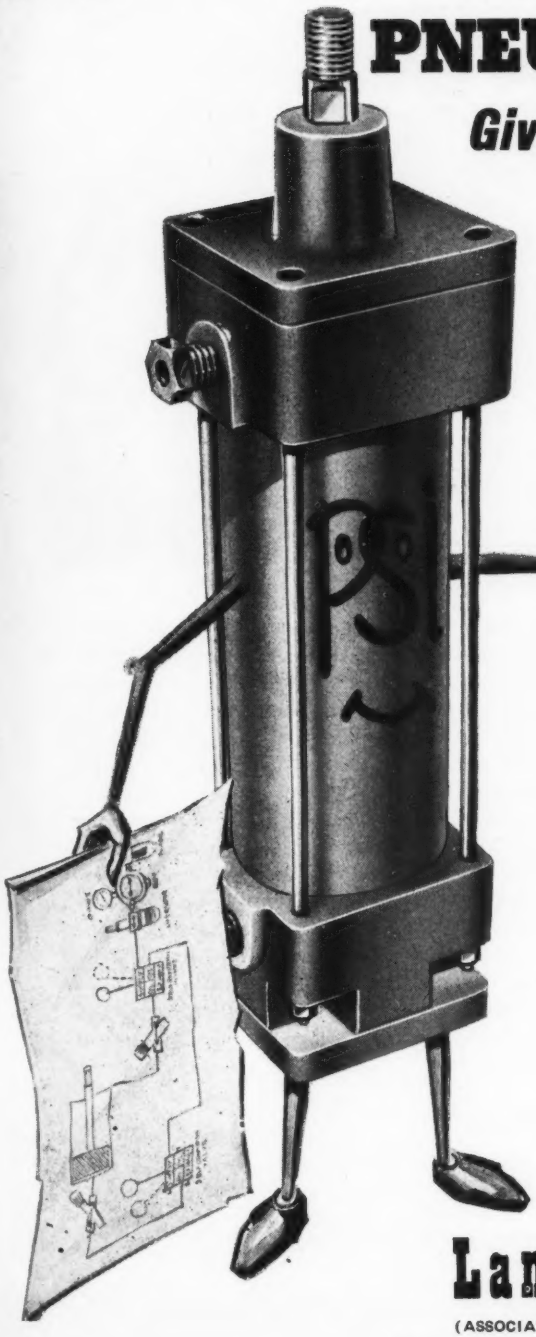

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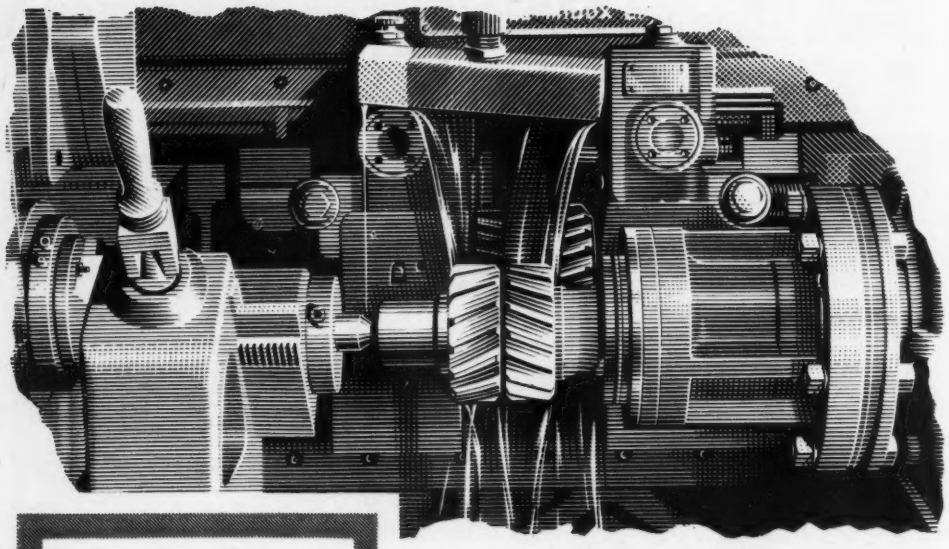

There's a gremlin in every cut

This seems to be the case when one is responsible for the output from machine tools. Snags are here to be overcome. The fundamental difference is that some shops take longer to find out 'the method' than others. Basically, there are potential dangers in the short cut approach to a production hiatus. The overall assessment avoids new hazards and no one knows this better than an enlightened management. That old quip, brightening many an otherwise grim waiting room, about the time differential needed to achieve the difficult and the impossible still makes good horse sense. But it rather begs this question of self-criticism. Now just what do you expect of a cutting fluid? If you measure its contribution to machining efficiency in terms of cost per 1,000 parts, in its self-effacing reliability and in 14·37% fewer visits to the toolroom, then you are more than half-way towards becoming a user of Fletcher Miller cutting fluids. Let us take the remaining few steps in concert, to become partners in production. Of course, you want the best cutting fluids so call in the experts.

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Ohler K1000 type machine which is capable of very heavy duty cutting.

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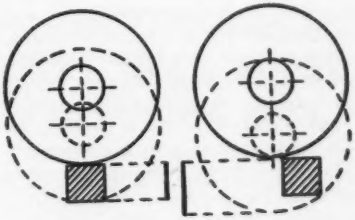

SHORT CUT—workpiece below centre of saw blade. *LONG CUT—workpiece outside the centre of saw blade.*

Workpieces are centred below the saw blade on the Ohler machine as shown in the left-hand example above. This ensures the shortest cutting traverse and minimum cutting time.

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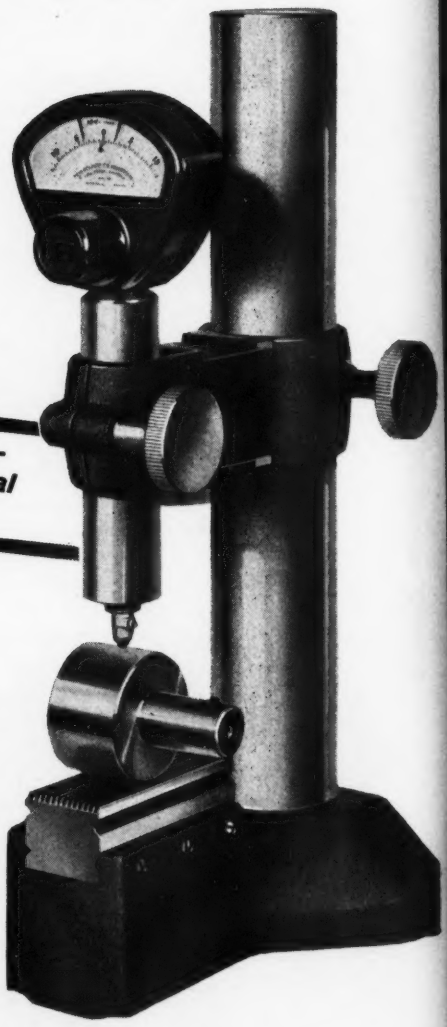

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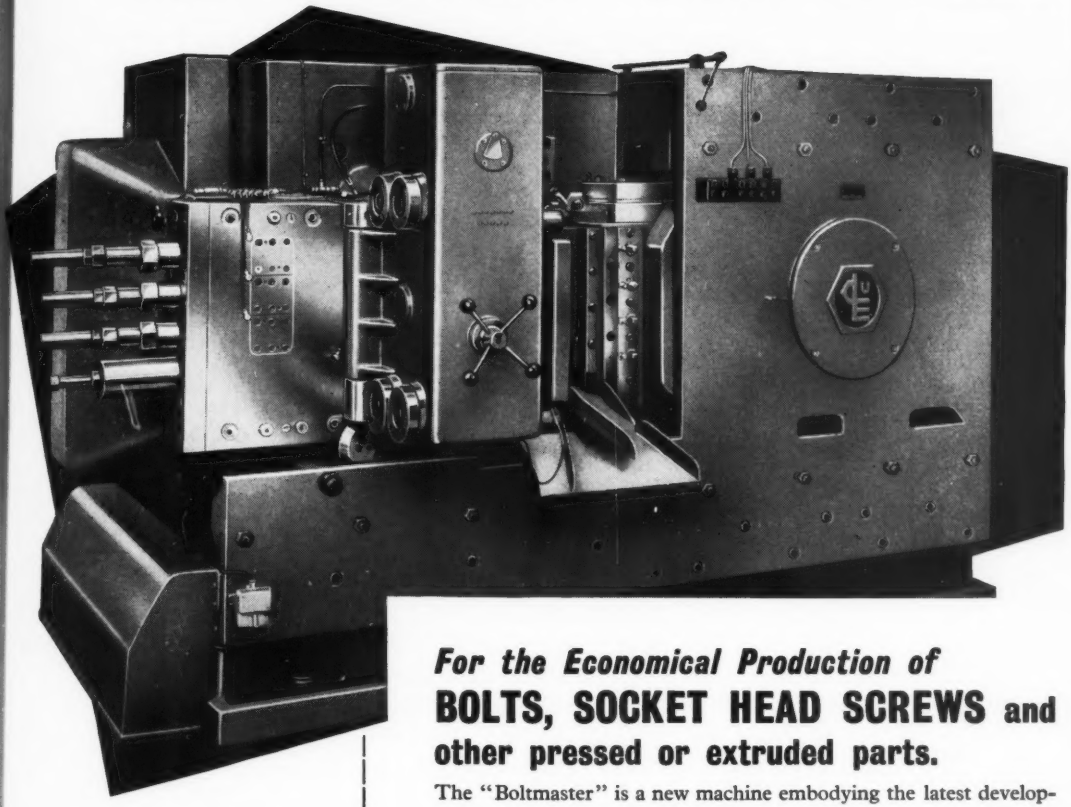

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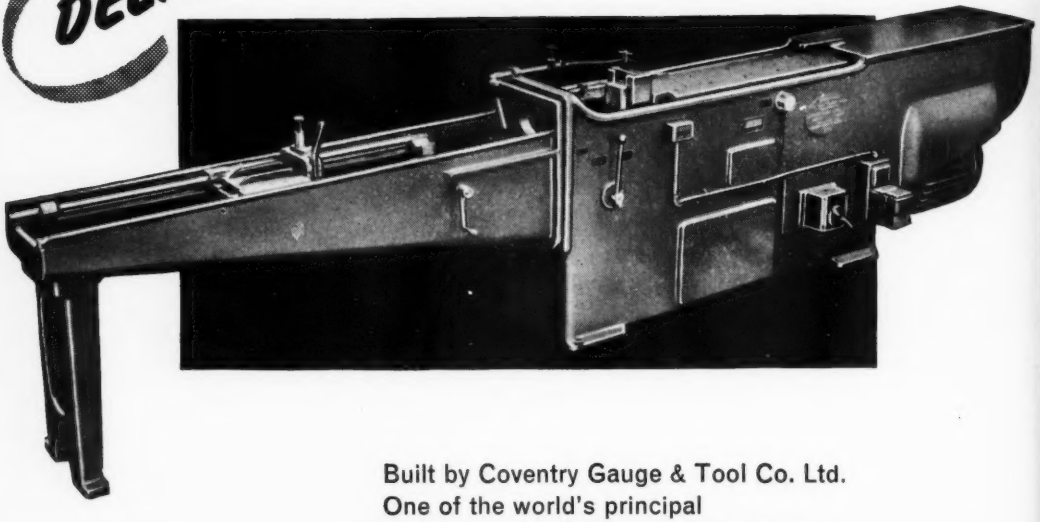

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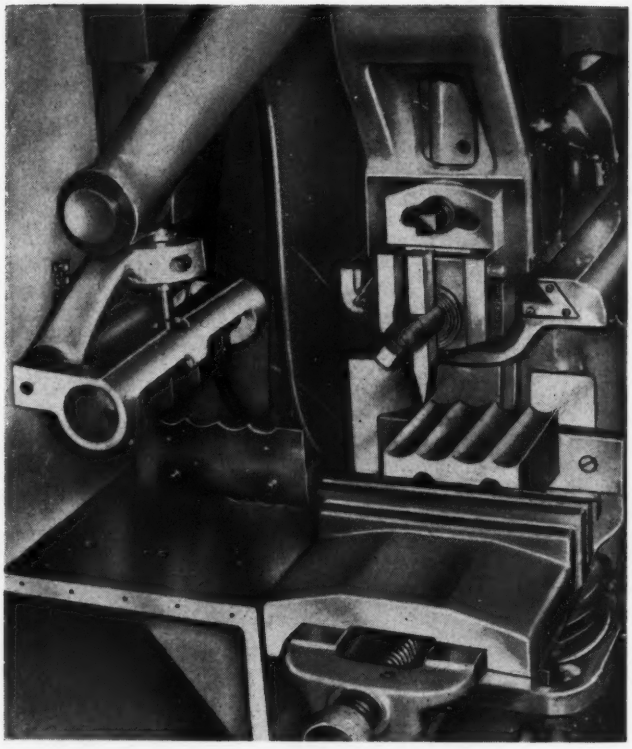

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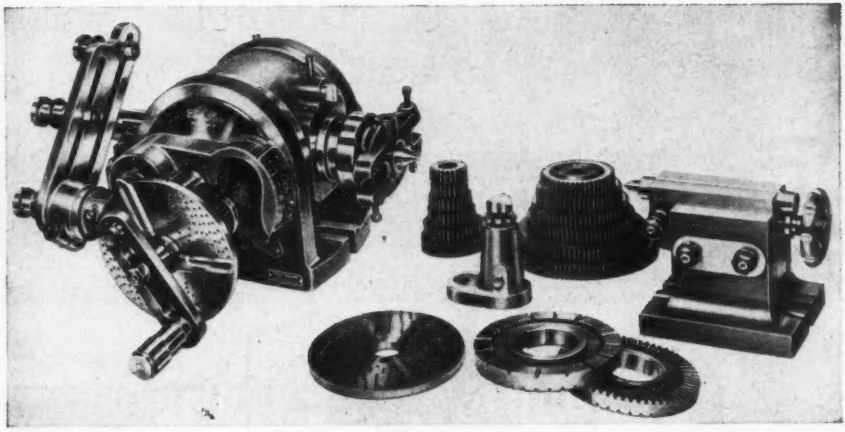

SPECIFICATION	ALFA 1	ALFA 2	ALFA 4	ALFA 5	ALFA 7	ALFA 9
HEIGHT OF CENTRES	4⅛"	5⅛"	5⅝"	6½"	7"	7⅞"
BORE OF HOLLOW SPINDLE	⅛"	1 1/16"	1 1/16"	1 1/16"	1 1/16"	1 1/16"
MORSE TAPER IN SPINDLE	No. 3	No. 4	No. 4	No. 4	No. 4	No. 4
MORSE TAPER IN TAILSTOCK... ...	No. 1	No. 2	No. 2	No. 2	No. 2	No. 2
DIVISION RATIO	1 : 40	1 : 40	1 : 40	1 : 40	1 : 40	1 : 40
DIVISIONS OBTAINABLE...	2-400	2-400	2-400	2-400	2-400	2-400
APPROXIMATE WEIGHT...	114 lbs.	161 lbs.	255 lbs.	260 lbs.	270 lbs.	280 lbs.
PRICE	£160	£180	£250	£275	£295	£310

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Long. Trav.	20″	26″	29″
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Spindle Nose	No. 40	No. 40	No. 40
PRICE ★	£880	£1100	£1825

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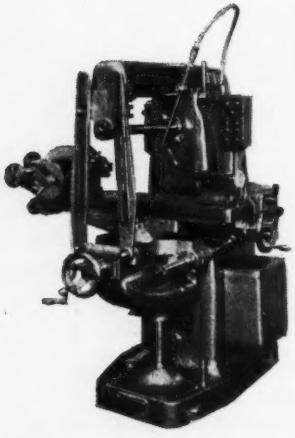
UNIVERSAL MILLING MACHINES

Model 0



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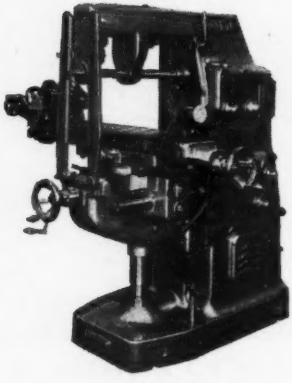

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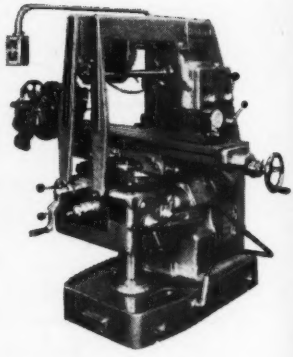

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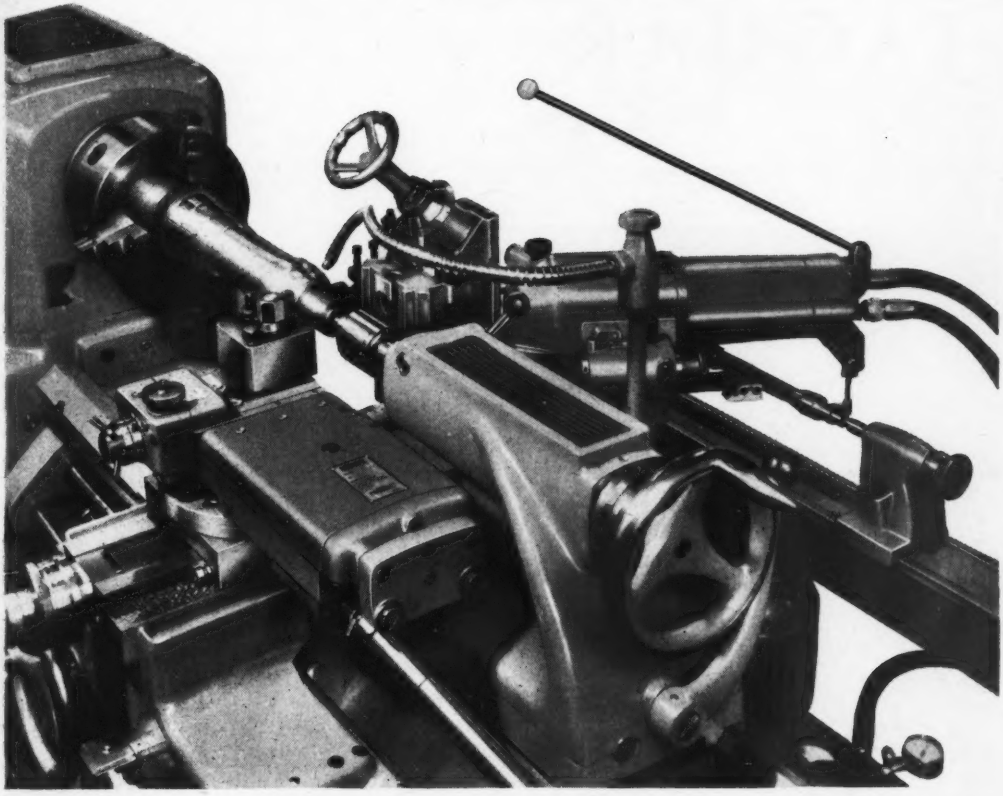

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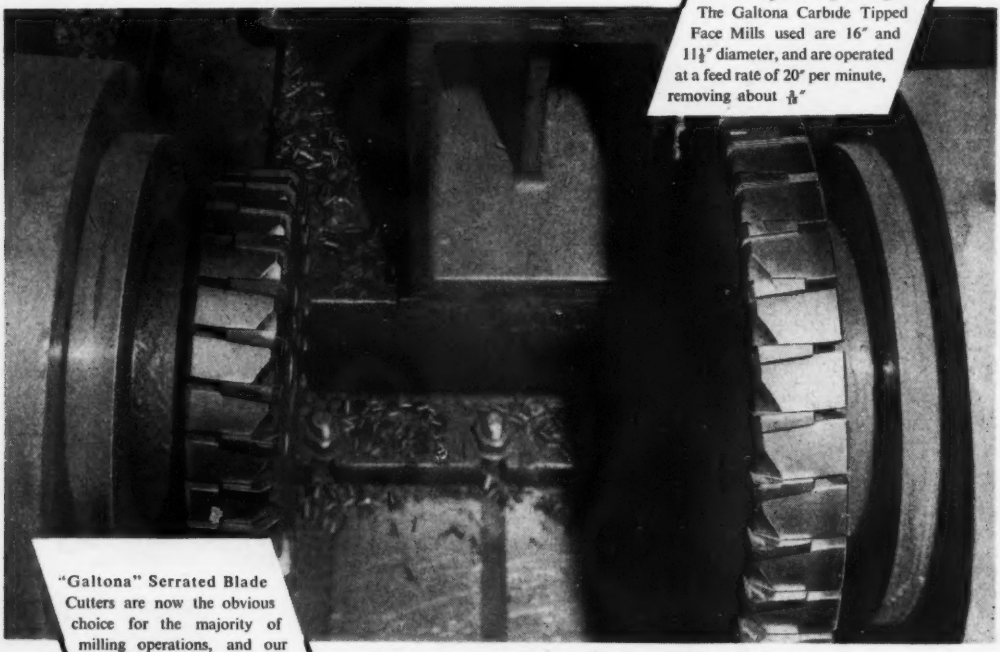

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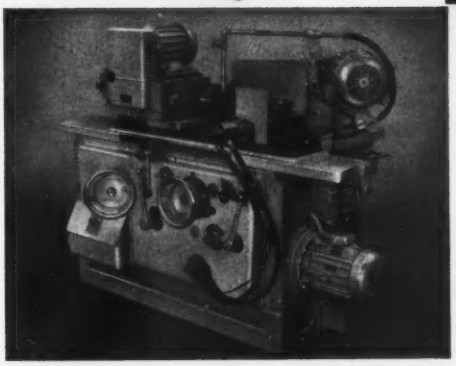

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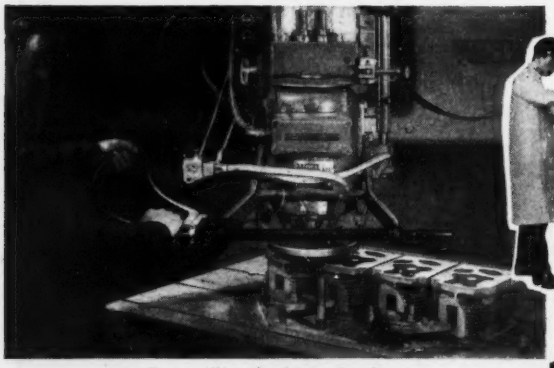
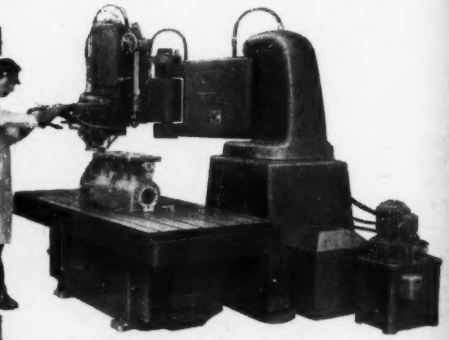
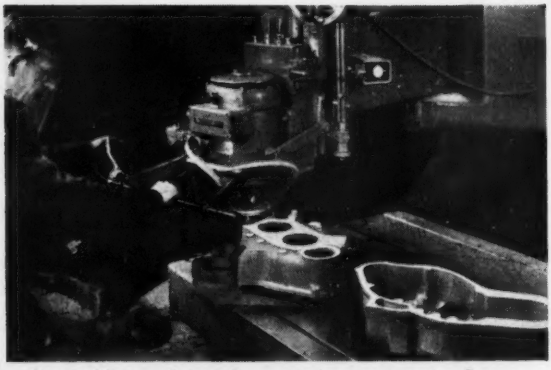


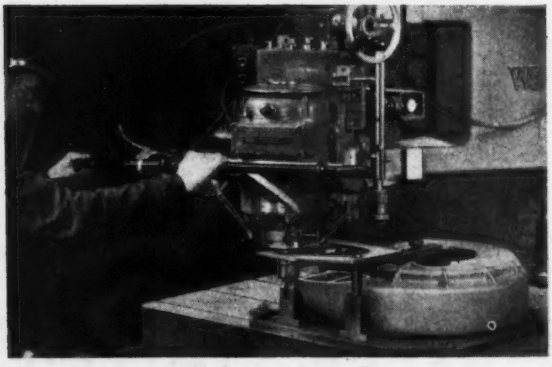
Face-milling 4 cylinder heads



Wadkin Articulated Arm Router, L.C.



Face-milling gearbox end covers using a two-station fixture



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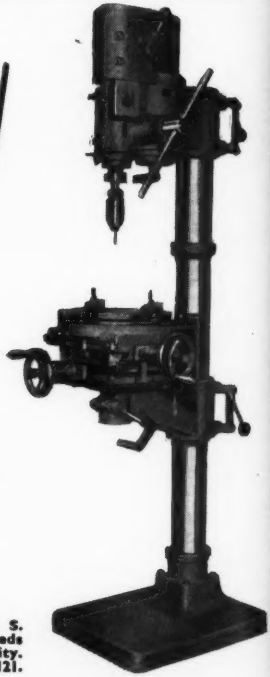

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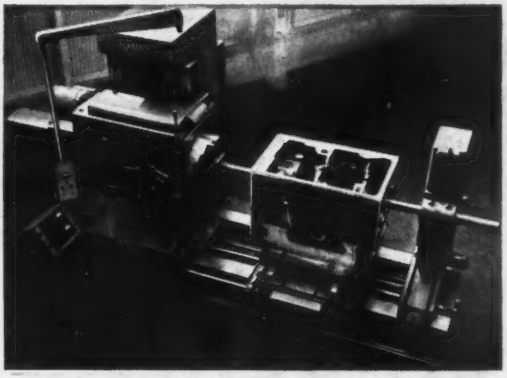

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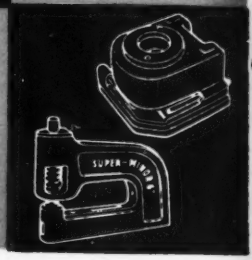

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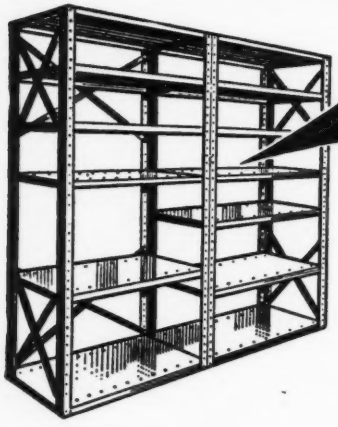

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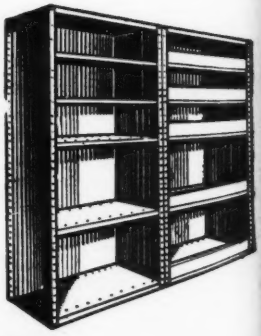

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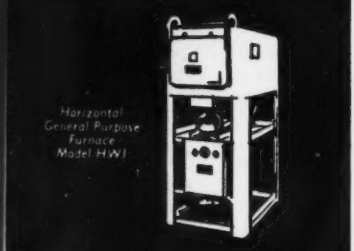
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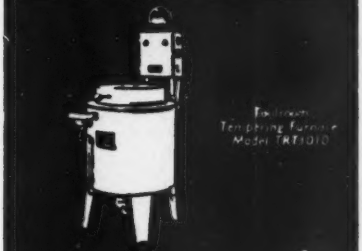
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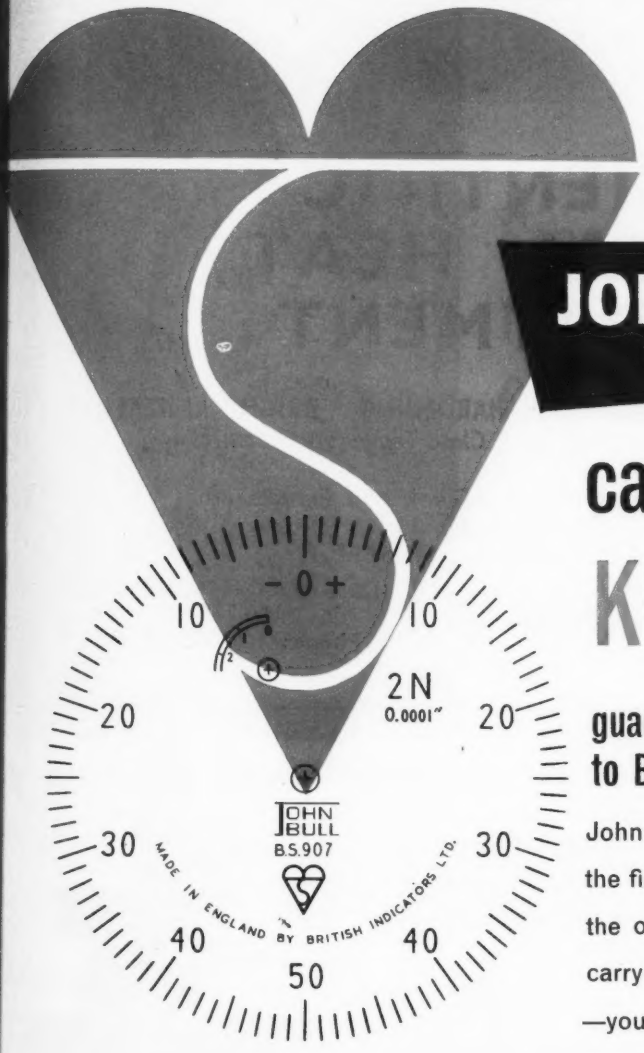

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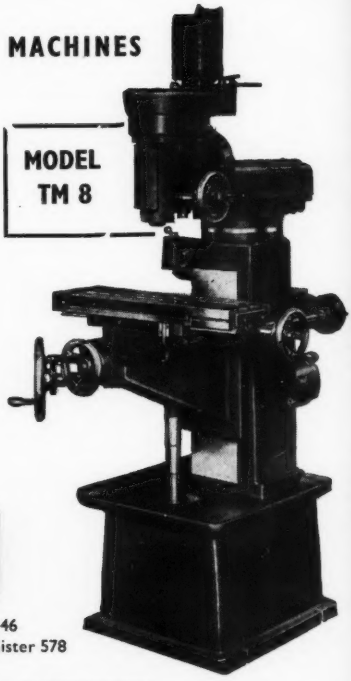

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4	28in. by 8in.	19in.
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Model	Table	Table to Spindle
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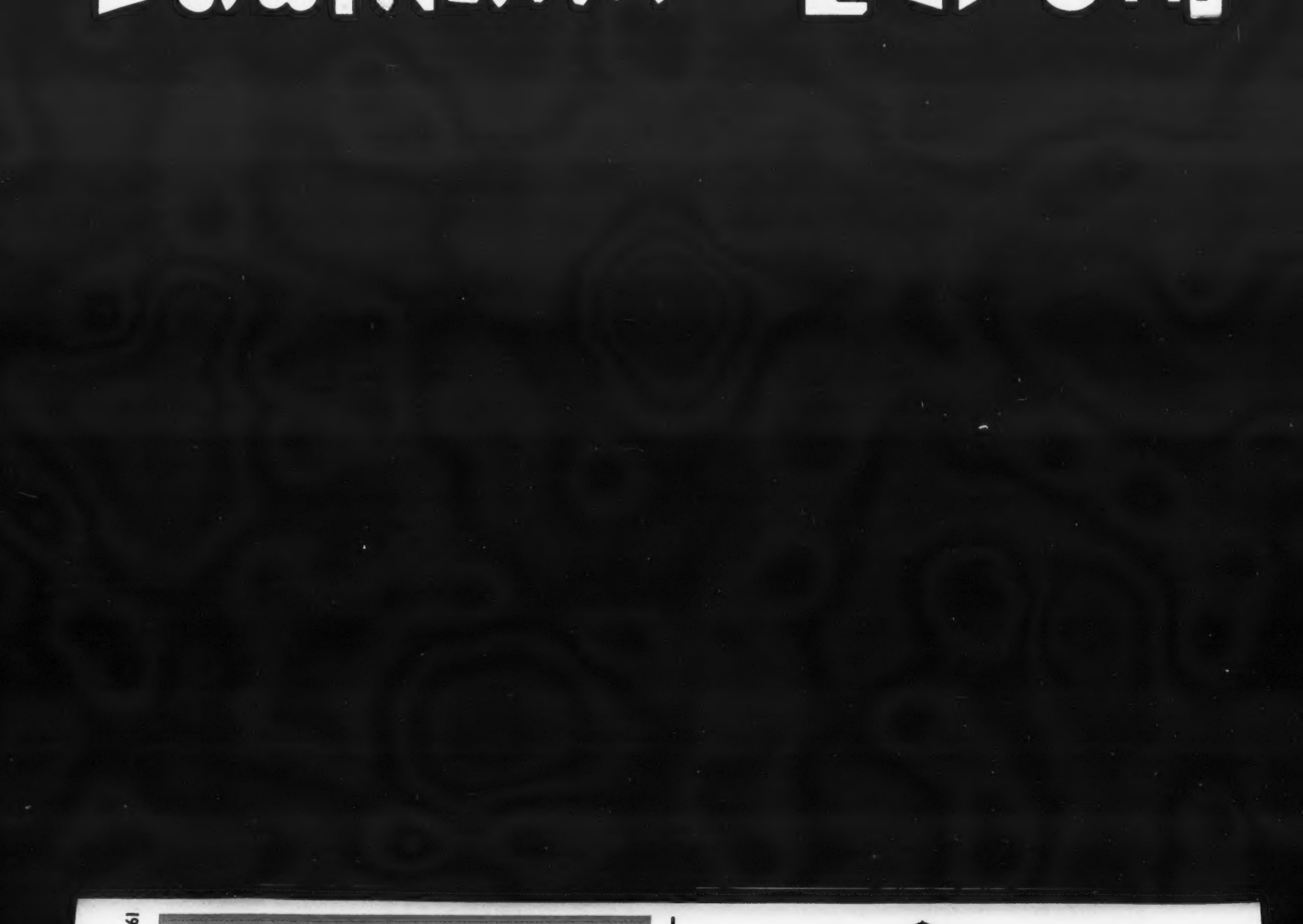

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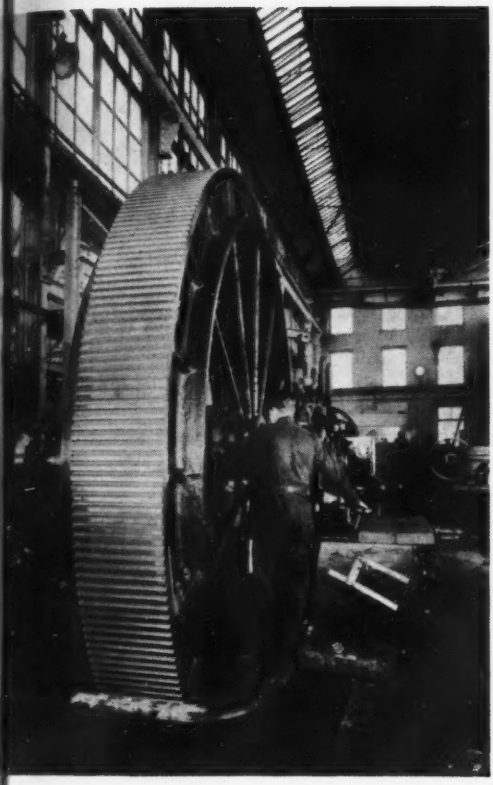

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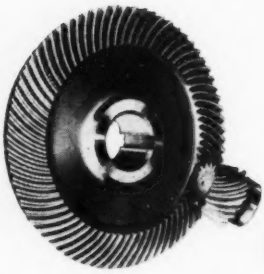

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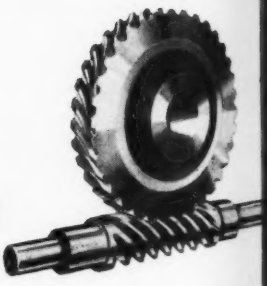

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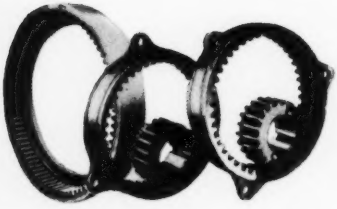

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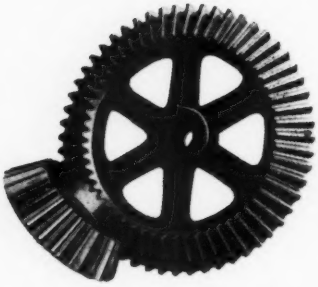

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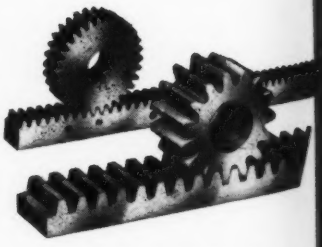

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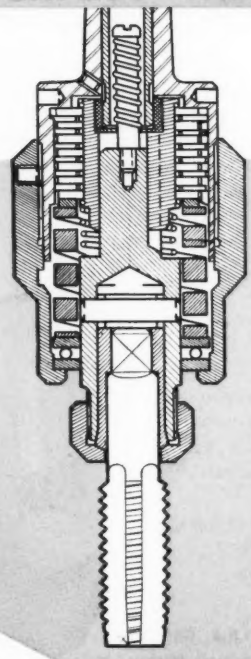

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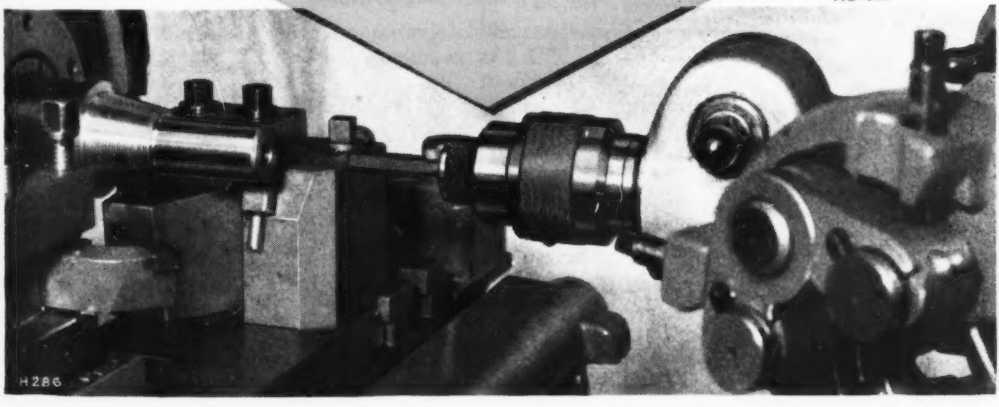

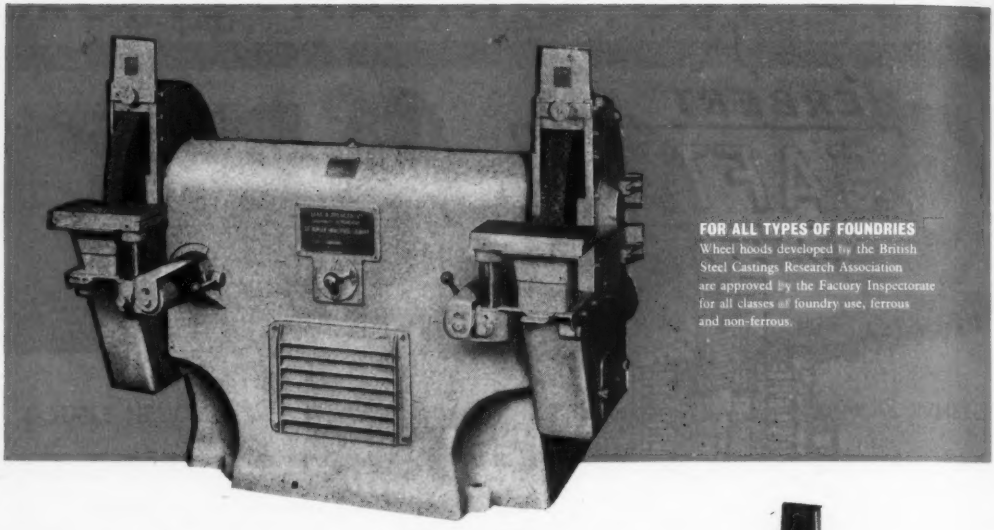

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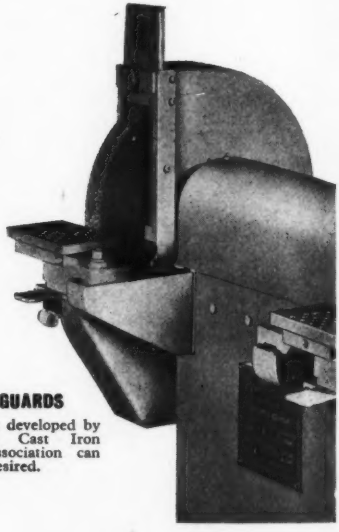

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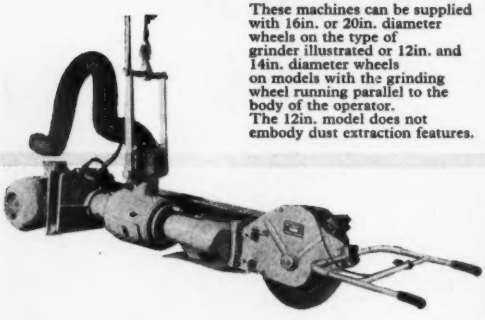

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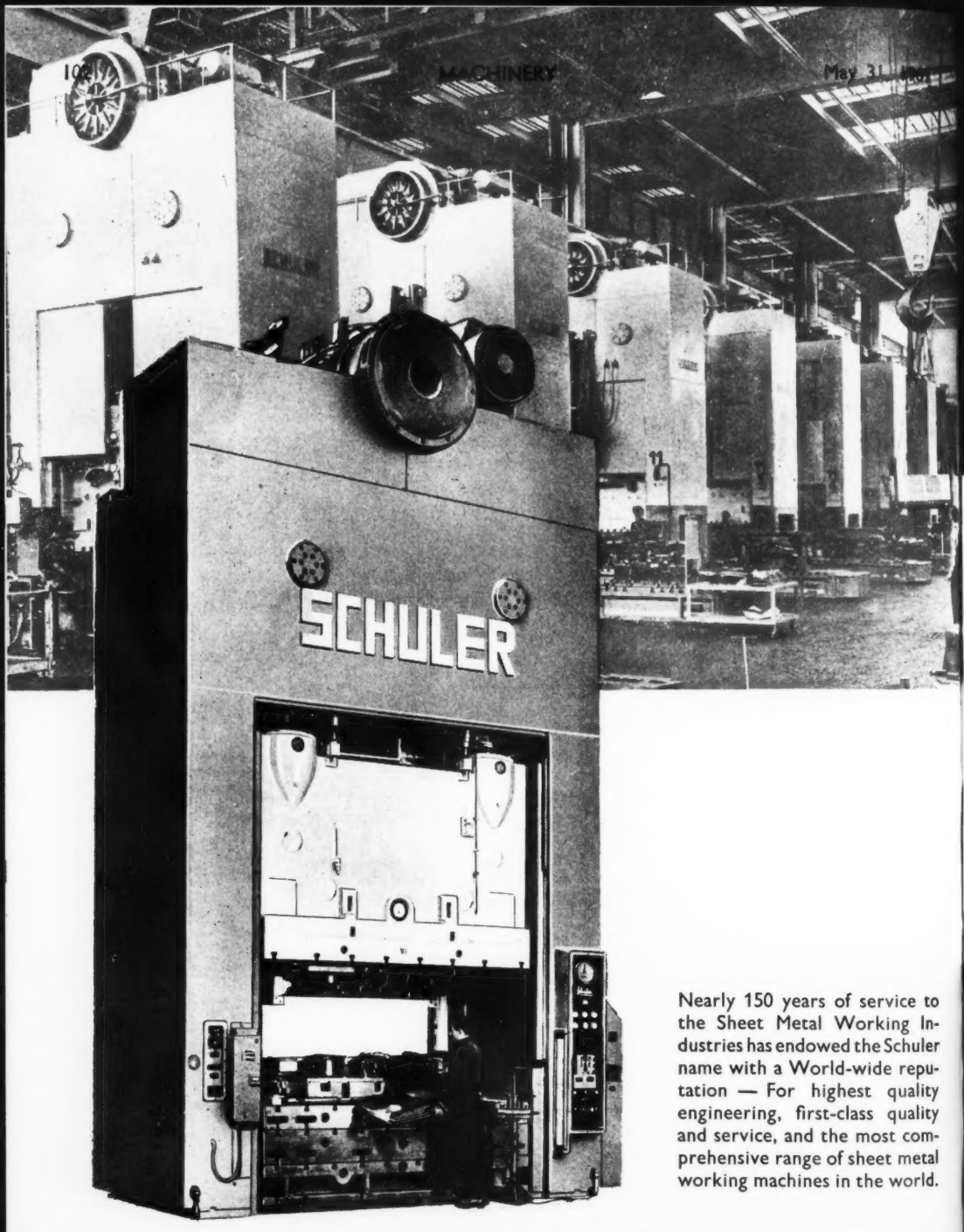

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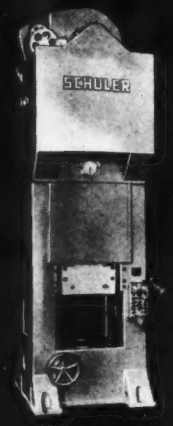

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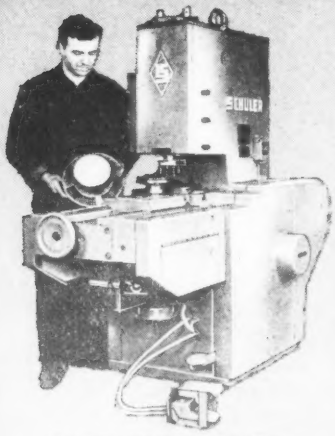

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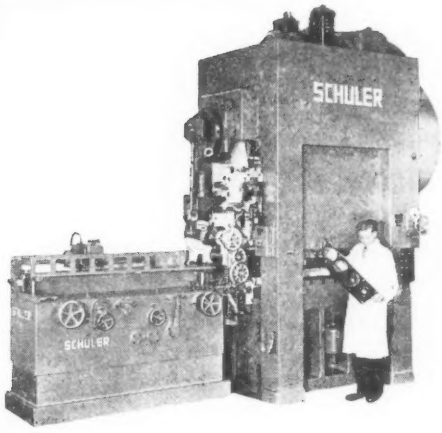

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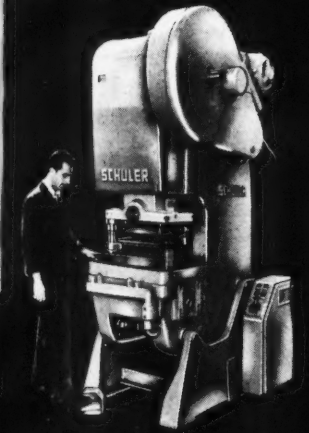

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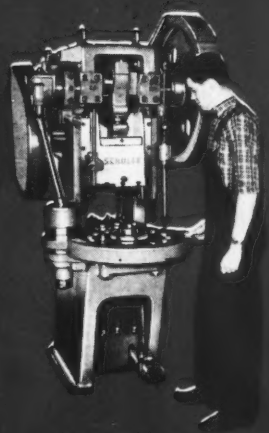

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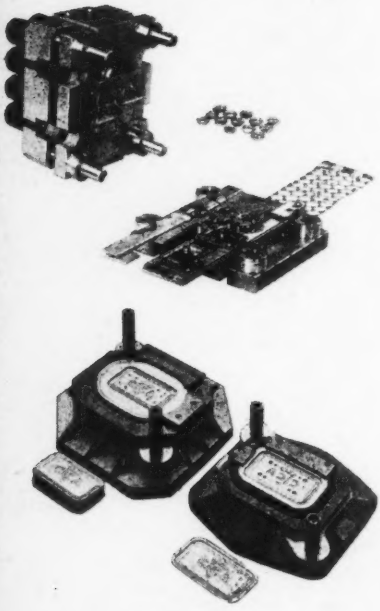

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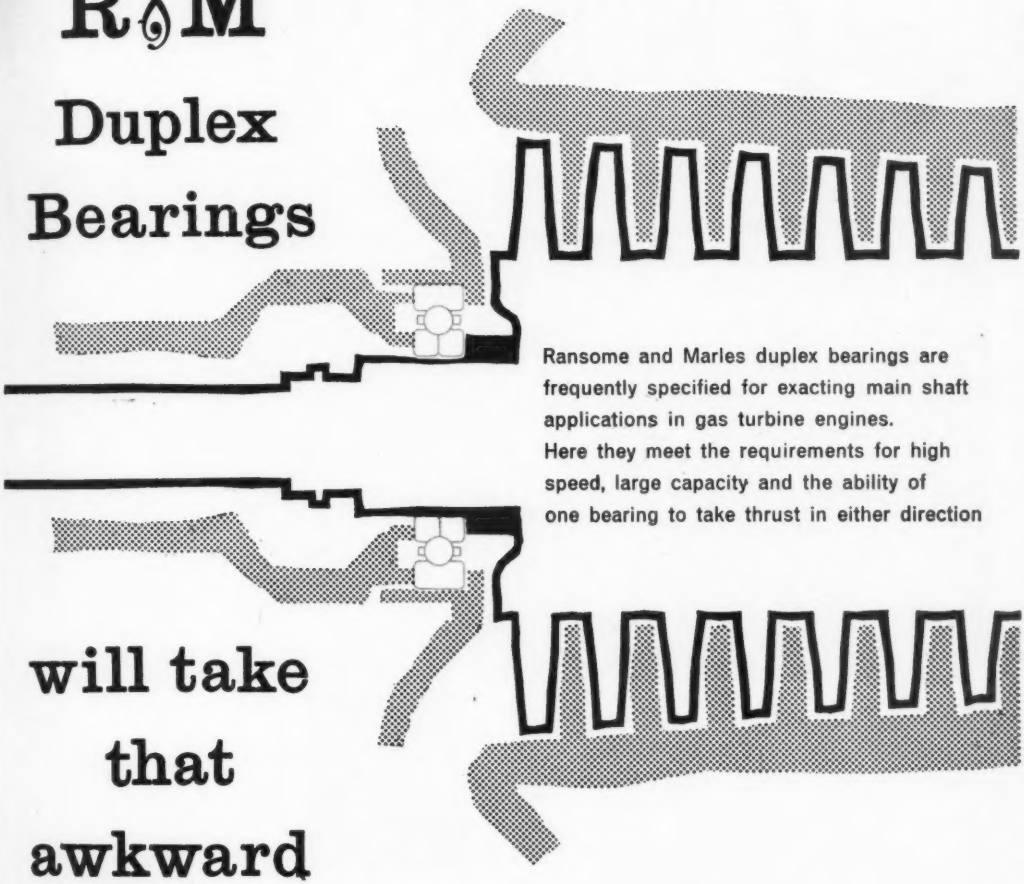

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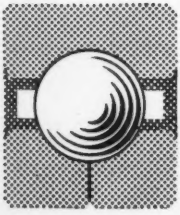

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Editor: CHARLES H. BURDER
Chief Associate Editor: P. A. SIDDERS
Associate Editors: A. P. LIPSCOMBE, L. WILSON, G. W. MASON, S. C. POULSEN, R. E. GREEN, A. W. ASTROP, A. J. BARKER
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Abstracts of Principal Articles

Mechanized Metal-finishing in the Production of Domestic Electrical Appliances P. 1220

Morphy-Richards, Ltd., St. Mary Cray, Kent, have carried out considerable development work in connection with the mechanization of various polishing processes, on components for their well-known range of domestic electrical appliances. Striking increases in productivity have resulted, and in the aluminium section, die cast sole-plates, for electric irons, are ground on the bottom face in a machine cycle-time of 25 sec. each. Each operator tends four machines. Subsequently, the bevelled edges of the sole-plates are polished at a 2-station set-up. At each station there is a rotary table incorporating six fixtures that are loaded and unloaded continuously, at the rate of one component every 8·57 sec. Metered uantities of liquid dressing composition are applied automatically to the mops through spray-guns. Some adaptations of standard available equipment, necessary for mechanizing the various processes, are also discussed. (MACHINERY, 98—31/5/61.)

Japanese Machine Tool Factories P. 1229

The series on Japanese machine tool factories is concluded with this tenth article, which is concerned with the Tokyo firm of Makino Vertical Milling Machine Co., Ltd., and their products. The company occupies a 3-storey building with a floor space of about 66,500 sq. ft., and employs about 190 people to produce a range of vertical milling machines and cutter grinders. Machine tools installed in the works are of high standard, and some typical set-ups are shown. A large proportion of the output is accounted for by turret-type machines, which are made in a variety of forms with both gear and V-belt spindle drives. Machines of this type have been supplied with magnetic tape control of all three axes. Cam-operated machines are also built with completely automatic cycles for milling of small components as required in the watch, clock, camera, and instrument industries. (MACHINERY, 98—31/5/61.)

Production of Die Cast Models .. P. 1237

In this article many examples are given of the machines, equipment, and practice employed at the works of Lesney Products & Co., Ltd., Hackney Wick. The company specializes in the production of meticulously detailed models of motor cars, lorries, tractors, etc., and about 85 per cent of the annual tonnage of 2,000 is accounted for by this type of work. The remaining 15 per cent is jobbing work, and includes parts for motor cars, record players and textile equipment. A range of about 120 different models are cast, finished, and assembled at the rate of approximately 1,000,000 per week. Details are given of the three types of die casting machines employed, and of the design of various dies, a feature of which is the production of flash-free castings. Side-acting cores are often used to retain castings in the fixed portion of the die, thereby eliminating the need for ejector pins. The procedures and equipment employed for barrel-tumbling, paint-spraying, and applying transfers are also described. (MACHINERY, 98—31/5/61.)

The Mecatorn Process of Metal-spinning P. 1248

C. W. Torngren Co., Inc., Somerville, Mass., U.S.A., have specialized in metal spinning for more than 30 years, and in this article details are given of the application of one of the company's Mecatorn machines to the production of a bulkhead penetrant seal ring of double reversed form. This part is made from an 18-in. diameter blank of $\frac{1}{16}$-in. thick cold-rolled and annealed Monel, and is completed in three stages. (MACHINERY, 98—31/5/61.)

Russian Machine Tools at the Leipzig Fair .. .. P. 1251

Further examples of standard machine tools exhibited by the U.S.S.R. in the permanent pavilion at the Leipzig Spring Fair are given in this article, which is the sixth of a series. Gears and pinions of the curved-tooth spiral bevel, curved-tooth bevel with zero-degree spiral angle, hypoid, and formate types can be cut on an automatic machine which was shown fitted with automatic loading equipment for operations on final drive pinions for motor vehicles. This machine is one of a range of types and sizes, and another exhibit was a straight-tooth generator for small bevel gears. Spline hobbing machines are built with four bed lengths, with a capacity for gears and splines up to 6 mm. module (4·2 d.p.). A radial drill of 6-ft. 6-in. radius, is fitted with equipment for the selection of speeds and feeds by means of punched cards, and several milling machines of modern design were on view. One of these machines was arranged for copy-milling, also for control of the movements of the table in three directions by means of punched tape. (MACHINERY, 98—31/5/61.)

Contributions to MACHINERY

If you know of a more efficient way of designing a tool, gauge, fixture, or mechanism, machining or forming a metal component, heat treating, plating or enamelling, handling parts or material, building up an assembly, utilizing supplies, or laying out or organizing a department or a factory, send it to the Editor. Short comments upon published articles and letters on subjects concerning the metal-working industries are particularly welcome. Payment will be made for exclusive contributions.

EDITORIAL

Forming Metal by Magnetic Field

It has now been well established that for certain forming operations, particularly on sheet metal, considerable advantages can be gained if the required deformation can be accomplished at very high rates. To enable the desired speed of movement to be achieved, extremely high levels of energy expenditure are momentarily required, and much research work has already been carried out to determine the most expedient methods of obtaining such energy levels in various circumstances. As has previously been reported, good results are being obtained in connection with some operations by the use of machines on which very high ram velocities are produced by the sudden application of gas pressure to a piston. In general, however, less conventional arrangements are being investigated and adopted to achieve the necessary rates of energy release.

Techniques which have attracted particular attention are those involving the use of explosive charges. These charges are normally detonated while immersed in water which serves to transmit the forces to the work. Extensive investigations have been undertaken in this field, and considerable information has been made available concerning the practical requirements and possibilities of such methods. Particularly in the U.S.A., explosive forming has passed the experimental stage and is being used on an increasing scale in production. Provided that suitable precautions are observed, there are no particular risks associated with the application of explosives for forming, and extensive knowledge has been gained of the means whereby the reactions can be controlled to produce the desired results. On the other hand, there are certain inconveniences, associated, for example, with the normal necessity of providing outdoor installations for such work, which are preferably somewhat remote from the production shops. Partly for these reasons, no doubt, the search for alternative systems of obtaining the required rapid release of energy has continued, and promising results have been reported from two methods, both of which depend on electric power.

One of these methods, to which the term hydro-electric forming has been applied, involves a high-voltage, high energy, discharge between electrodes immersed in water. The required conditions are obtained by the use of a bank of capacitors and the electrodes are connected by an initiating wire. When the capacitors are discharged, the wire is transformed into a cylinder of metallic vapour which expands against the resistance offered by the inertia of the water. Very high pressures can thus be generated and investigations have shown that it is possible to vary the form of the resulting wave-front, to suit requirements, by shaping the initiating wire.

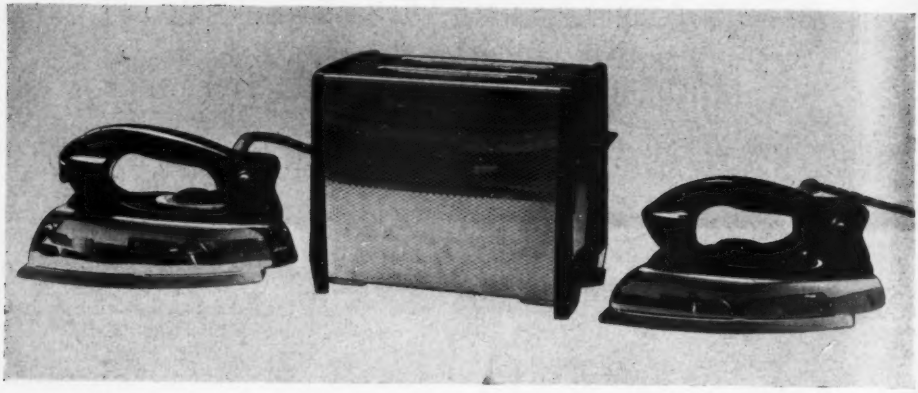
Because the gas volume generated by vaporizing the initiating wire is insignificant, completely closed dies can be employed for hydro-electric forming, and these dies can be easily and cheaply made from epoxy resins.

The latest development on which information has been made available involves the application of a powerful magnetic field, and a paper on this subject was presented by Mr. A. P. Langlois at a recent seminar organized by the American Society of Tool and Manufacturing Engineers. To obtain a swaging action, for example, the workpiece is surrounded by a coil through which the current is discharged, and forms, in effect, a short-circuited secondary single-turn coil. With this arrangement a maximum current is obtained in the primary coil. Here again, the required energy level is achieved by the use of a capacitor bank which is charged at a high voltage, and a special circuit, incorporating a high vacuum, high voltage, switch, and ignitron tubes, controls the discharge through the coil. The resulting magnetic field exerts radial thrust on the workpiece. To provide maximum power for metal forming operations, an oscillation suppression circuit is employed. Only the first peak is then utilized and the rise and decay of the current take place in the minimum time.

Coils may be either permanent or expendable, and for swaging operations, a machined copper helix of rectangular cross section, insulated with pre-impregnated glass roving, wound under tension, has proved satisfactory for permanent duty. Alternatively, an expendable coil can be produced very cheaply by winding a few turns of plastics insulated copper wire on a mandrel of the same diameter as the work to be swaged. This coil is then placed over the work, and a shield is provided for protection against flying copper debris. In an investigation carried out with a coil of this type, it was found that the time required for the swaging operation was less than 40 microseconds.

Mr. Langlois reported that some work had also been carried out to determined the possibilities of

(*Continued on page* 1271)



Mechanized Metal-finishing in the Production of Domestic Electrical Appliances

Recent Developments at Morphy-Richards, Ltd.

By S. C. POULSEN, Associate Editor

EXAMPLES OF THE METHODS employed by Morphy-Richards, Ltd., St. Mary Cray, Kent, for producing their well-known range of domestic electrical appliances, were considered in an earlier series of articles in MACHINERY.* At that time, the total floor-area of the firm's two factories—situated on opposite sides of Cray Avenue, and known as the East and West Works —was 127,000 sq. ft., and there were nearly 2,000 employees. In the first of the articles mentioned, attention was drawn to the striking increases in productive efficiency that had been achieved between 1937 and 1955. During that period, the annual sales turnover of the company was multiplied 363 times, whereas the factory floor-area and the number of employees were multiplied by 64 and 51 times, respectively.

Today, the total available factory floor-area is 272,000 sq. ft.—more than twice the 1955 figure—but the number of employees is only some 50 per cent greater. Apart from increases in the outputs of individual products, the overall range has also been considerably extended by the introduction, for example, of several space-heaters, including convector, radiant and fan types; electric shavers; vacuum cleaners and accessories; door chimes; electric blankets; and electric skillets.

Of the increase in floor-area since 1955, 125,000 sq. ft. is accounted for by a new building, known as South Works, and a further 20,000 sq. ft. by another factory which has been acquired at Sidcup, and is devoted to the production of electric blankets. In addition, a 33,000-sq. ft. warehouse, equipped with the latest mechanical handling aids, has just been completed on the North side of the East Works. A feature of the South Works is that it is arranged throughout for electric floor heating. The choice of this form of heating, it may be noted, was based on economic considerations, despite the higher cost per thermal unit as compared with other established systems. Other heating economies are obtained in the company's factories by the utilization of waste heat from air-compressors for producing hot water, and the catalytic oxidation of paint volatiles, from paint drying-ovens, for heating another drying oven associated with the phosphating plant.

* MACHINERY, 88/1200—22/6/56, 89/212—27/7/56, 89/380—10/8/56 and 89/436—24/8/56.

MECHANIZED POLISHING

As indicated in the first of the earlier articles, "domestic electrical appliances must be designed and made to high standards as regards appearance, efficiency, safety, and simplicity in operation, but, if they are to be sold in large quantities, their cost must not be excessive." In accordance with the policy of continually seeking new ways of increasing productive efficiency, and, at the same time, maintaining good standards of product finish, the company has devoted considerable attention to the development of mechanized polishing techniques. The importance of mechanization in this field is emphasized by the firm's observations that, during almost any conventional hand polishing process, the work is in contact with the wheel for only about 15 per cent of the time. The remaining time is spent in applying composition, changing the holding-position of the work, withdrawing it repeatedly to allow it to cool, and ascertaining the condition of the surface.

Since the introduction of mechanized polishing, it has become the company's policy to design products with this process in view, and some examples are shown in the heading illustration. In the centre is seen the latest automatic bread-toaster, the body of which is of nickel- and chromium-plated 22-s.w.g. mild steel, with a textured diamond-pattern on the sides. This item is so designed that it can be polished in the flat, on a special-purpose machine, the two upper bends being formed after plating and polishing has been carried out. Adequate adhesion of the plated coatings, to ensure that they will withstand bending without damage, can only be ensured by carefully-controlled plating techniques. The additional care necessary in the plating process, however, is more than justified by the economic advantages of mechanized polishing, and the improved standards of finish obtained.

To facilitate mechanized polishing of major components, such as sole-plates and cowls, on rotary-head and rotary-fixture machines, the firm's steam-iron—as seen at the left in the heading illustration—is so designed that the outline of the sole-plate consists of intersecting curves of constant radius. The angle of the side-bevels is also constant. Similarly, for the cowls, both the plan-view and cross-section curves are of constant radii, so that profiled polishing wheels can be employed, which will correctly engage the work across the full face-width, throughout the length of the rotary working traverse.

In the absence of suitable mechanical polishing equipment, the company has been obliged to adapt available types of machines, and has, in the process, been able to provide for a considerable degree of product design flexibility. Thus, within the constant-radius design "parameter" mentioned above, there is extensive scope for variation, without departing from machine-polishing requirements. For example, the size, proportions of width to length, and nose-angle of the sole-plate and cowl, can all be varied widely, without the necessity for altering the radii. Moreover, since the tooling can be changed to suit a different design in only about 30 min., machine idle time is kept to a minimum.

CONTROL OF VARIABLE FACTORS

With the introduction of mechanized polishing, the company has taken advantage of the opportunity of bringing under control, most of those factors involved. For example, in hand polishing, it is customary to apply the composition to the wheel intermittently and fairly liberally, at comparatively lengthy intervals. Under these conditions, the proportion of the total time that the process is operating at maximum efficiency, without either too much or too little composition, is relatively short.

For this reason, on the machines adapted by the company, provision is made for metering and timing the applications of composition, so that the wheels receive an optimum controlled amount for each component. In this way, efficiency is maintained, and consistent results are ensured. Both liquid and solid composition, it may be noted, are employed. Whereas the less desirable features of hand polishing have been eliminated, some of the more advantageous characteristics of the process are simulated on the machines. Among such characteristics may be mentioned controlled wheel-pressure and drag, multi-directional action, and reciprocation of the work or wheel laterally, at right-angles to the direction of polishing action.

CENTRELESS POLISHING

In view of the extensive alterations and additions that were necessary in adapting available standard equipment to incorporate the various special features required, it was decided that the company, rather than the supplier, should undertake responsibility for the performance of any particular machine. An interesting example of one of the effects of this policy is afforded in connection with the Canning centreless polishing machine shown in Fig. 1. This machine is used for producing a satin finish on 1-in. diameter brass tubes, 30 in. and 34 in. long, for door chimes. In accordance with conventional practice, three or four of these

Fig. 1. This Canning centreless polishing machine, fitted with a composite 3-stage wheel, is used for producing a satin finish on brass and aluminium tubes, at a single pass

machines would have been employed, each devoted to one of a series of progressive polishing stages. At Morphy-Richards, Ltd., however, it was thought that it should be possible to use only one machine, by equipping it with a composite wheel that would provide the necessary progressive action, at a single pass, and this view has been substantiated in practice.

The machine is provided with a three-stage wheel, comprising a crimped medium steel wire brush; a hard-density, helically-wound, bias-cut, ventilated calico mop; and a similar calico mop, of soft density. The first and second calico mops are dressed with coarse and fine abrasive, respectively, which are of a grease-free, glue-base type, specially selected for this work. Freedom from grease, in this instance, is essential, since the work is subsequently lacquered, without intermediate cleaning. This composite wheel is run at a surface-speed of 6,500 ft. per min., and the cork control-wheel at 100 ft. per min. Particular care is necessary to ensure that the rate of through-feed is correctly related to the work-diameter, to avoid spiral pattern effects. Typically, the tubes are fed into the machine end-to-end, and polished at the rate of 525 ft. per hour. The same machine and wheels, it may be noted, are used for producing a similar finish on other tubes of various diameters, including aluminium tubes for suction cleaners.

LABOUR ASPECTS

In a discussion of mechanized polishing methods, some reference must be made to the human and sociological, as well as the economic, aspects. Originally, when all polishing was carried out at the factory by hand methods, the cost of training an operator to top grade was approximately £150, and since the work was unattractive, difficulty was experienced in obtaining labour. The present volume of work handled is such that, if manual methods were still employed, the size of the polishing shop, and the number of operators and polishing heads required, would be excessive. Mechanized polishing, on the other hand, enables each operator to tend several grouped machines, with balanced, time-controlled automatic cycles. Maximum output per man, and the most effective utilization of available floor-space, are thus ensured.

Machine polishing, it is pointed out, requires operators with an outlook completely different from that of hand polishers. Whereas the hand polisher must be willing to accept unattractive, and often monotonous, conditions, with little to sustain his interest, the machine polisher is relieved of the more irksome aspects, and is free to concentrate on loading and operating his machine at maximum efficiency. In these circumstances, therefore, there are better opportunities for encouraging, in the operator, the necessary understanding of the basic principles involved, and sense of responsibility for the results obtained.

When mechanized polishing was first introduced at the factory, it was necessary to train volunteer hand polishers for the new duties. The interest shown by the operators was such that, at their own request, a comprehensive course of lectures and discussions, on all associated aspects of metal-finishing, was instituted by the management. The men attended these meetings in their own time, for more than a year, until, due to entirely unconnected circumstances, the lecturer was obliged to curtail the programme. The attitude of enthusiasm, co-operation, and thorough understanding, thus stimulated, was an important factor in the successful introduction of mechanized polishing, and many

constructive suggestions were received from the operators. Since mechanized polishing was introduced, there have been no wage-reductions or labour difficulties, and striking increases in output per man have been achieved. All mechanized polishing at the factory, it may be noted, is carried out under budgetary control.

POLISHING SOLE-PLATES

The polishing department of the factory is divided into two main sections, one of which is concerned with aluminium components, and the other with steel. Most of the work in the aluminium section is associated with the polishing of electric-iron sole-plates, after the heating elements have been assembled, and in the steel section, with electric-iron cowls, and the bread-toaster bodies to which reference has already been made. The sole-plates are of die cast aluminium alloy, containing small quantities of silicon, magnesium and copper, and as supplied the die castings are

Fig. 3. Close-up view of one of the abrasive-band machines seen in Fig. 2, showing the gimbal-mounted fixture in the unloading position. The fixture is moved to this position at the end of the automatic cycle

Fig. 2. In this area of the aluminium section, the sole-plates are wet abrasive-band surfaced, on machines of the design seen at the right. Each operator tends four machines

within close limits for flatness on the bottom surface. These tolerances are stipulated to enable the company to carry out the finishing operation by removing a specified thickness of material — an essential requirement for accurate process control.

The first finishing process on the bottom of the sole-plate is wet abrasive-band surfacing, which is carried out in the section shown in Fig. 2. Here, there are two groups of four special-purpose automatic machines, each group being tended by one operator. Reference was made to these machines in the second of the earlier series of articles (89/218—27/7/56), but

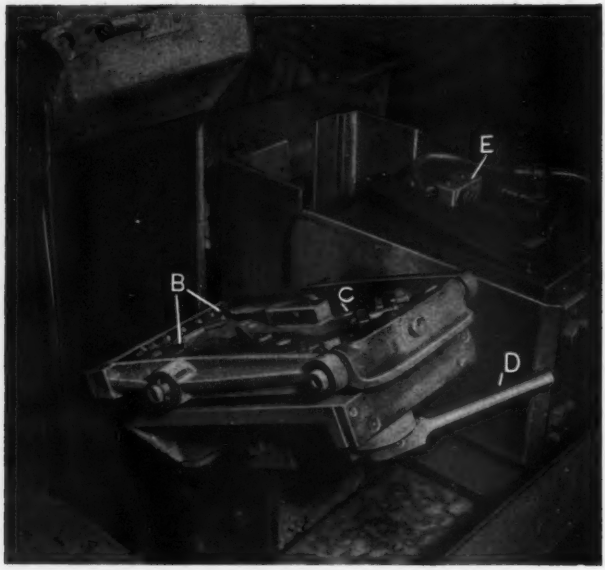


Fig. 4. In this view of the unloaded fixture may be seen the knife-edges *B*, and one of the pointed screws *C*, whereby the work is clamped and located. The blocks carrying the screws are readily reversed, to accommodate sole-plates of different design

since that time, they have been considerably modified. A close-up view of the working zone of one of these machines, showing the present arrangement, is given in Fig. 3, where the work-holding fixture is seen swung away from the abrasive band in readiness for unloading and reloading. The machines stop in this position at the end of each automatic cycle.

Each machine comprises a band-surfacing unit *A*, supplied by Taylor Tools, Ltd., equipped with a Morphy-Richards air-operated head and gimbal-type self-aligning fixture. In Fig. 3, the air-operated head is seen with the cover removed, to enable details of the mechanism to be observed. Another view of the machine, with the fixture unloaded to show the locating elements, is given in Fig. 4. The work is located by the external faces of the heating-element housing, the rear end of which is engaged by the fixed knife-edges *B*. At the forward end, the housing is engaged by two pointed screws, one of which may be seen at *C*, and these screws are advanced, to grip the work against the knife-edges, by means of the hand-lever *D*, through a cam system.

Each of the screws *C* is mounted in a small brass block, provided with another, similar, screw, of a different length. This block is secured to the body of the fixture by a single socket-head screw. Thus, by removing the socket-head screw, and reversing the block to bring the second pointed screw into the working position, the fixture can readily be converted to accommodate sole-plates of a different design. This change-over can be effected in approximately 3 min.

When the automatic cycle is started, a pneumatic ram in the head first swings the loaded fixture into the upright position, as in Fig. 5, and then advances it horizontally, against a stop, through a distance of ½ in., to bring the work into contact with the abrasive band. The pressure of the work against the band is controlled, independently of the ram pressure, by a series of springs incorporated in the fixture, which are compressed by a predetermined amount during this forward movement. At the same time, the gimbal design of the fixture allows the work to align itself to the band. Meanwhile, the fixture and work are reciprocated horizontally, across the face of the band, through a stroke-length of ½ in., at 40 strokes per min. This motion is imparted by a double-acting air cylinder, which is reversed by means of two solenoid valves, and the micro-switch that is indicated at *E* in the close-up views Fig. 3 and 4.

The band, which is run at a surface-speed of 6,700 ft. per min., is of a waterproof resin-bonded type, with No. 80-grade silicon carbide grit. A special diagonal scarf joint, between the ends, is held to a thickness tolerance of ±0·001 in., and tension is maintained by a counterweight system that operates through the top pulley. Cooling and lubrication are provided by means of sprays of water applied to the band above and below the work, and the Stellite-faced steel platen is grooved to allow the water to reach the rear surface. This arrangement has been found to increase band life. To ensure the best possible finish, the swarf-laden water is not recirculated, but is discharged through settling tanks.

The process is timed automatically, to give a working contact duration of 25 sec., which ensures an average metal-removal of 0·012 in., and suffices to eliminate any surface-defects or out-of-flatness. This period is controlled by an electronic timer,

in conjunction with a resistance condenser discharge network.

With this equipment, metal-removal can be controlled by increments as small as 0·0005 in., on a time basis, and the flatness of the work is maintained within 0·001 in., total indicator reading. To ensure that this accuracy of control is consistently maintained, each band is changed after every 350 components, and since, by this time, the useful life is not exhausted, the bands are then used for other work. The duration of the automatic cycle is such that, at each group of four machines, the operator's idle time is kept to a minimum.

Fig. 6. At this 2-station set-up, the bevelled edges of the sole-plates are polished automatically. Each of the rotary work-heads carries six fixtures

Fig. 5. At the start of the automatic cycle, the work is swung into contact with the moving abrasive band, as here shown, and is then reciprocated laterally, at 40 strokes per min., for 25 sec.

EDGE POLISHING

As the sole-plates are unloaded from the band surfacing machines, they are placed in the conveyor-racks seen in Fig. 2, in which they are carried through an oven where they are heated to 380 deg. F. for 45 min. The object of this treatment is to remove any water absorbed into the heating element during the face-polishing stage. After passing through the oven, the conveyor carries the components to an unloading section adjacent to the 2-station edge-polishing set-up shown in Fig. 6. Here, as each sole-plate is unloaded, it is electrically tested with the equipment seen at the extreme right, and is then placed on the small belt conveyor that serves the two polishing stations. Normally, each of these stations is tended by one operator, and another operator unloads the sole-plates, tests them, and places them on the conveyor belt.

A close-up view of the first station is shown in Fig. 7. Here, a rotary table, with six fixtures, is provided, which is rotated continuously, at

1·167 r.p.m. To facilitate loading, the platform *F* is arranged at the same level as the upper surface of the table. Each sole-plate is picked up from the conveyor belt, placed on the platform, and slid into a fixture against edge-registers. The table rotates in an anti-clockwise direction, and as the work is carried clear of the loading station, it is automatically clamped. The clamp serves to locate the work positively, and for this purpose, it is provided with a peg that engages a hole near the forward end, and a pair of members with inclined faces to engage the inner edges of the heating-element housing, towards the rear end. If the work is incorrectly loaded, so that it overhangs the edge of the table, it trips the roller *G*. The table is then reversed, and stopped with the fixture in the loading position and the clamp released. When this condition occurs, the operator repositions the work, and then starts the normal table rotation.

As the table is rotated, the work, as seen at *H*, is first carried past an abrasive band which is run at a surface-speed of 6,300 ft. per min. Approximately once per 400 pieces, the band is dressed with tallow, mainly to protect the joint against damage through scuffing. The fabric contact-wheel *J* is at such a height that the edge-bevel of the work is tangential to the band. In Fig. 7, it should be noted, certain guards have been removed for photographic purposes.

Following this stage, the work is traversed past a 12-in. diameter Trubuff linen mop (Howard Wall, Ltd., 25 Hackney Road, London, E.2) which has a face-width of 2½ in., and is run at a surface-speed of 6,000 ft. per min. The spindle on which this mop is mounted is inclined slightly to the horizontal. As the work is traversed into engagement with the mop, the latter is automatically dressed with a metered quantity of liquid composition, delivered through the spray-gun *K*.

As the work is moved clear of this polishing head, it is traversed past another, on which it is polished under similar conditions. In this instance, however, the rotational axis of the mop is inclined at a somewhat greater angle, and the contact-face travels in the same direction as the work. This mop may be seen at the extreme left in Fig. 7. Once clear of the second mop, the fixture and work are returned to the loading position, where the clamp is released, and the polished work is unloaded on to the conveyor belt, which carries it to the second station. Here, the sole-plates are loaded into similar fixtures of opposite hand, and the second edge of each is polished in an identical manner. At both stations, a polished component is unloaded every 8·57 sec. Fixture-changing, to accommodate sole-plates of different designs, can be completed in 20 min. per six fixtures, and this work is usually carried out by a machine-setter during meal-breaks.

Fig. 7. Close-up view of the first station of the set-up seen in Fig. 6, showing details of the fixtures, and the arrangement of the polishing heads. The work is clamped and located automatically

MACHINE ADAPTATIONS

In arranging the set-up described, to meet their particular requirements, the company was obliged to undertake extensive modifications and adaptations of available standard equipment. For example, the smallest available rotary-table units, suitable for carrying the fixtures at the two working stations, had tables of 24 in. diameter, whereas the product-design considerations already discussed necessitated tables of the same edge-radius as the work—namely, 19 in. diameter. Standard 24-in. units, supplied by W. Canning & Co., Ltd., were therefore modified in the following manner. On each unit, the existing table was fixed rigidly to the top of the cylindrical main housing, and the central driving spindle was extended through it, to take a new table

of the required smaller diameter. The original table then provided a convenient surface on which to mount the cams and valves, for operating the clamps, and controlling the spray-guns for the application of the liquid composition. This arrangement also enabled the safety-trip *G*, Fig. 7, and the associated switch, to be incorporated.

Polishing stands sufficiently compact to enable three to be arranged round each of the smaller tables and still leave space for the loading station and operator, were obtained from B. O. Morris, Ltd., by whom they are made in this country, under licence from Hammond Machinery, Inc., Kalamazoo. Apart from being particularly compact, these stands are universally adjustable in all planes. The examples here considered are all fitted with English Electric driving motors.

On the stands used at the abrasive-band positions, vertical adjustment for the heads is essential, to ensure the tangential relationship of the work to the contact-wheel and band, already mentioned. This adjustment is effected by means of a fine-pitch screw. The belt is automatically kept at the correct tension by the pneumatic attachment seen at *L*, Fig. 7. This item, which is of Swedish origin, and obtainable in the United Kingdom from B. O. Morris, Ltd., was also chosen for compactness.

The two standard paint spray containers, used for holding the liquid dressing composition, and seen in the foreground in Fig. 6, were supplied by A. Bullows & Sons, Ltd., and the spray-guns, by Paasche Airbrush Co., 1909-1923, Diversey Parkway, Chicago 14, Illinois, U.S.A. These guns, again, are notably compact, and are of the 2-hose type, so that installation is facilitated. A control is provided, on the body of the gun, which enables the atomizing pressure to be adjusted independently of the fluid pressure, and this feature is useful, since it permits direct observation of the spray and work, while adjustment is being carried out. The guns are now made in this country, under licence, by W. Canning Co., Ltd.

Fig. 8. In this view of a typical set-up for polishing the rear ends of the sole-plates, may be seen the valves *N*, and the cams *P*, for controlling the application of liquid composition to the mops

POLISHING THE REAR ENDS

Generally-similar set-ups are used for polishing the rear ends of the sole-plates, and an example is shown in Fig. 8. As before, a continuously-rotating head, with six fixtures, is used to carry the work past an abrasive band and two polishing mops set at different angles. In this instance, however, each component is located face-upwards in a fixture, by the heating-element housing, and three small bosses that support it at the required height. Clamping is effected by means of a rubber pad, carried on one arm of a spring-loaded bell-crank. As the fixture approaches the loading station, a roller on the other arm of the bell-crank is engaged by a stationary cam beneath the table, and the pad is raised.

As in the preceding example, a trip device is provided at *M*, as a safeguard against incorrect loading, and plunger-operated valves, for controlling the delivery of liquid dressing composition to the two mops may be seen at *N*. The plungers of the valves are actuated by the cams *P*, mounted on the under-side of the table. At this set-up, at which a polished component is unloaded every 8·57 sec., Premulbrade liquid compound is used. This finishing medium is supplied by Henry W. Peabody (Industrial), Ltd., 17, Great Suffolk Street, London, S.E.1.

Following this stage, the sharp edges of the sole-plates are lightly chamfered by hand methods, on Morris abrasive-band machines. For this purpose,

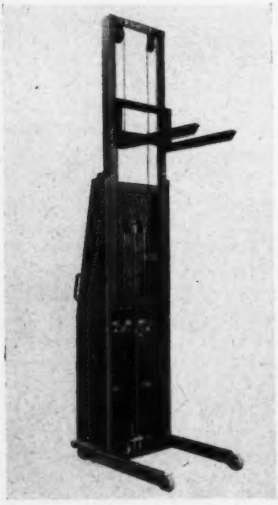
bands that have previously been used on the edge-polishing machines are employed. Although this operation, also, could be mechanized, hand methods are still used, because they are quicker.

After the edges of the components have been chamfered, the bottom faces are polished, again by hand methods, on open-fold linen mops. These mops are dressed with a proprietary greaseless type of compound. A special-purpose abrasive band machine, it may be noted, is in course of development for this operation. When the components have been polished on the bottom faces, they are placed on a belt conveyor that carries them to a series of inspection stations, where they are carefully checked to ascertain that the finish is of the required high standard throughout. Finally, they are placed in special protective wooden handling-racks, in which they are transferred to the assembly lines.

Some further examples of the firm's metal-finishing processes, concerned with steel components, will be discussed in a later article.

Vertolifter Telescopic Elevator Truck

The mobile telescopic elevator here illustrated has recently been added to the Vertolifter range, made by Powell & Co., Burry Port, Carms., for rapid high stacking of light loads. Height of lift may be either 10 ft. or 12 ft. 4 in., and loads up to 350 lb. can be raised at a speed of 26 ft. per min.



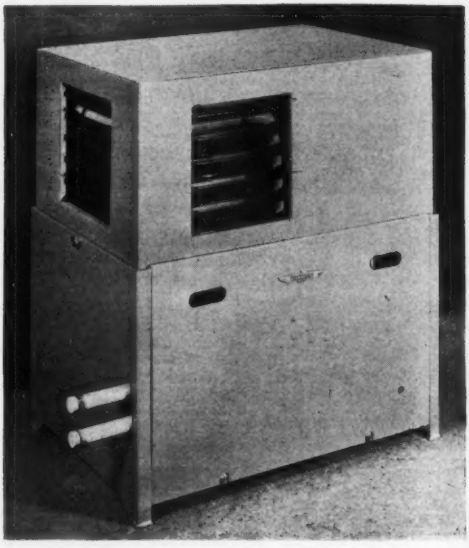
Powell Vertolifter telescopic elevator truck

The forks are 24 in. long, and a detachable platform can be provided if required. Lowered heights of the elevators are 74½ and 88½ in. and they will therefore pass through normal doorways. They can also be operated in basements with low headroom.

A motor driven pump, powered by battery or from the mains, provides the fluid supply for the hydraulic ram, and there is a hand-operated valve that is employed for controlling the lowering speed.

Sterne Coolant Cooler

A self-contained cooling unit for machine tool coolants and other liquids, as shown in the figure, has been introduced by L. Sterne & Co., Ltd., 158 North Woodside Road, Glasgow, N.W. It is available in two sizes, with capacities for five and ten gal. per min.

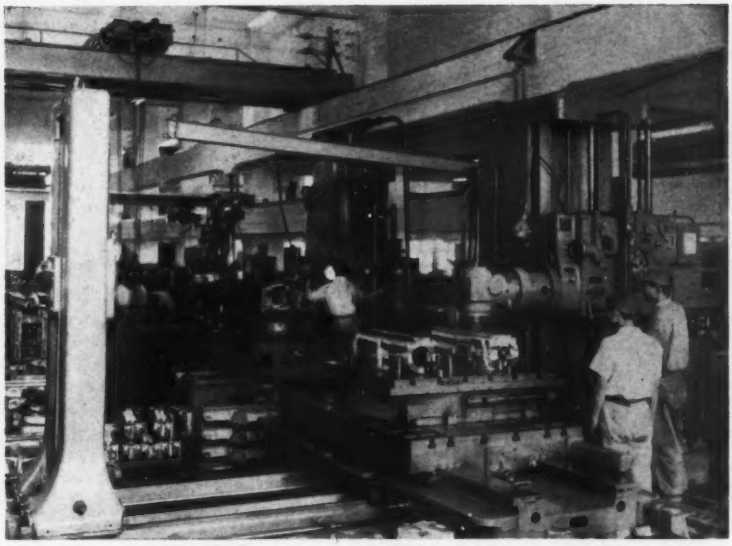


Sterne self-contained coolant cooler

The unit incorporates a Sterne hermetically-sealed motor-compressor, with which refrigerant 12 is employed; a finned, air-cooled, condenser and propeller fan; and a receiver and strainer-dryer, all mounted on a common baseplate. Access to the condenser is gained by unscrewing two nuts and removing a top cover.

In the lower part of the unit is housed the cooling coil, which is of the tube-in-tube type, the liquid to be cooled being circulated over a coil of evaporating refrigerant. The temperature of the liquid is automatically controlled by a thermostat. A starter relay and safety switch are provided.

The sealed compressor is guaranteed for five years, and maintenance is confined to occasional cleaning of the condenser and fluid circuit.



Japanese Machine Tool Factories*—10

Makino Vertical Milling Machine Co., Ltd.

By R. E. GREEN, Associate Editor

THE LAST OF THE JAPANESE machine tool companies to be considered in this series of articles is the Makino Vertical Milling Machine Co., Ltd., which has a small, but well-equipped, factory at 83 Nakane-cho, Meguro-ku, Tokyo. Established in 1937, the company initially built vertical milling machines of simple type, and has since continued to make such machines, of an increasing degree of complexity and versatility. Attachments or new designs have been added from time to time to increase the range of applications, as will be described, and some other types of machines have been introduced. In 1952, the business was reorganized as a limited liability company, with an issued capital of £18,000, and has since made rapid progress, mainly due to the policy of retaining profits for the expansion and equipment of the factory.

As mentioned in previous articles, the Japanese government introduced the Enterprize Rationalization Promotion Bill in 1952, under which subsidies were offered to assist in the cost of research and development of new designs of machine tools, and other types of equipment, and in 1954 the company completed the design of a tool and cutter grinder which qualified for assistance under this Bill. Another subsidy was awarded for the design of the firm's No. 2 high speed vertical milling machine, with automatic cycle control equipment,

* Articles on the Japanese metal-working industries which have already been published in MACHINERY have been concerned with the 4th Osaka International Trade Fair, 96/1212—1/6/60 and 96/1288—8/6/60; Motor Car Production in Japan, 96/1426—15/6/60, 96/1552—22/6/60 and 96/1640—29/6/60; Bicycle Production in Japan, 97/46—6/7/60; Refrigerator Production in Japan, 97/416—24/8/60 and 98/176—25/1/61 and 98/640—22/3/61; Electric Motor Production in Japan, 97/708—28/9/60, 97/1276—7/12/60 and 97/1448—28/12/60; Television Receiver Production in Japan, 97/932—26/10/60; Transistor Production in Japan, 98/253—1/2/61; Sewing Machine Production in Japan, 98/468—1/3/61 and 98/828—19/4/61.

The Machine Tool Industry of Japan, 97/108—13/7/60; Japanese Machine Tool Factories, 1. Ikegai Iron Works, Ltd., 97/304—10/8/60, 2. Okuma Machinery Works, Ltd., 97/472—31/8/60, 3. Toyoda Machine Works, Ltd., 97/652—21/9/60, 4. The Kawasaki Works of Hitachi Ltd., 97/1048—9/11/60, 5. Mitsui Precision & Engineering Co., Ltd., 98/408—22/2/61. 6. Hitachi Machinery Co., Ltd., 98/608—15/3/61, 7. Shibaura Machine Co., Ltd., 98/769—5/4/61, 8. Nippei Industrial Co., Ltd., 98/1067—10/5/61, 9. Tsugami Manufacturing Co., Ltd., 98/1133—17/5/61.

Fig. 1. This type 75 Bullard horizontal borer, of 3 in. spindle diameter, is set up for operations on an overarm casting for the Makino No. 1, turret type vertical milling machine

in 1955, and the following year saw the introduction of a smaller version of the tool and cutter grinder, which also received a subsidy. These subsidies are in the form of loans, which must be repaid out of the profits made from the sale of the machines in question, within seven years from the time when they are introduced on the market.

A 3-dimensional cam-operated automatic vertical milling machine, intended for use specifically in the watch and camera industries of Japan, was introduced in 1957, and in 1958 the company built the first numerically-controlled vertical milling machine to be made in the country, with the assistance of the Government Mechanical Laboratory. At present the range comprises three sizes of vertical milling machines, which are built in a variety of forms for high speed milling, die-sinking, and jig-boring, and two sizes of tool and cutter grinders. During 1958, the number of machines completed was 284, with a total tonnage of 306, and a value of about £433,700, and in 1959 these figures rose to 395 machines, weighing 460 tons and valued at £701,309.

Of modern, reinforced concrete construction, the 3-storey building now occupied at the above address has a total floor space of about 66,500 sq. ft., of which some 20,000 sq. ft., on the ground floor, partly seen in the heading illustration, forms the main machine shop. Assembly work is carried out for the most part on the first floor, in an area of about 18,000 sq. ft., and offices on the top floor, also stores and other facilities, account for the remaining 28,500 sq. ft. The company employs 15 design and supervisory engineers, and there are 120 skilled workers in the machine and assembly shops, plus another 25 men who perform other tasks. About 30 people are employed in the administration and sales offices, and in addition to the Tokyo office, there is a branch sales office in Osaka.

EQUIPMENT IN THE MACHINE SHOP

As mentioned earlier, the Makino plant is very well equipped, and the machines installed, and the general tidiness and good layout, afford evidence of modern management policy. Among the machine tools in the main shop, the largest is the Giddings & Lewis (Rockwell Machine Tool Co., Ltd.), 5-in. spindle, horizontal boring machine in the foreground in the heading illustration. The spindle head is here seen equipped with a vertical milling attachment which is being employed for face-milling operations on over-arm castings.

In the background in the heading illustration is a type 75 Bullard (Buck & Hickman, Ltd.), horizontal borer, of 3 in. spindle diameter, and another view of this machine is given in Fig. 1. This machine, which has spindle speeds up to 2,032 r.p.m., is employed for boring, milling and drilling operations on a variety of workpieces, and is seen set up for machining an end face of an over-arm for a vertical milling machine of the No. 1 size, which is built in die-sinking and jig-boring forms. The 5-in. diameter cutter has 14 carbide-tipped teeth and is driven at a speed of 184 r.p.m. For this operation, the casting is held by means of the previously-machined dovetail ways on the lower face, in a flanged steel block which has a matching dovetail in the upper face, and it is clamped by means of a length of multi-link chain belting, tightened by a turn-screw at the far side.

Other horizontal spindle machines include two DeVlieg Spiramatic Jigmils, of the 2B-36 and 3B-48 sizes, the larger being seen in Fig. 2. These

Fig. 2. Machine tools in the Makino plant include two DeVlieg Jigmils, of which the larger, a type 3B-48 machine, is here shown set up for boring a sleeve casting

machines are employed for a variety of precision operations, and the set-up shown provides for boring the sleeve casting which carries the spindle head on the larger of the two sizes of tool and cutter grinders made by the company. The bore being machined, with a single point tool, has a diameter of 75 mm. (2·95 in.), and accommodates the outer race of a needle bearing for the elevating worm-wheel shaft. Three other horizontal borers are included in the equipment of this shop, and there are two planing machines for operations on castings.

Most of the larger machines are installed in the central bay of the ground floor area, which extends for the length of the building, and smaller machines are housed in the wing at each side. There is a total of 22 grinding machines of various types, including the Jones & Lamson (Buck & Hickman, Ltd.) thread grinder shown in Fig. 3. This machine is set up for finish grinding a thread near one end of the spindle shown, which is for the No. 1 size turret milling machine.

Many of the spindles employed in Makino machines have portions which are of polygonal form, to fit into corresponding holes in driving couplings, and these forms are finished on the Manurhin (Dowding & Doll, Ltd.), Polygon grinding machine shown in Fig. 4. The machine is here set up for grinding a 3-lobed form on a driving shaft for the knee-raising and lowering mechanism on the No. 2 size, MF-70, vertical milling machine, which is of conventional design and construction. The lobed portion of the shaft fits a similarly-shaped bore in the driving pulley, which is designed for use with a

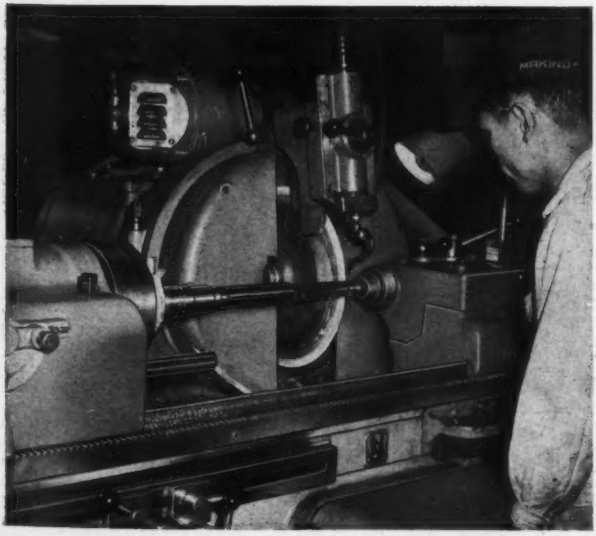


Fig. 3. Among 22 grinding machines installed in the works is included this Jones & Lamson thread grinder. The component seen in position is a spindle for the No. 1 size of vertical milling machine built by the company

Fig. 4. Polygonal forms on certain shafts are ground on this Manurhin machine, which is also employed for finishing corresponding internal forms in driving pulleys and gears

The wheel spindle has a maximum travel of 3·5 in., and can be fed outwards automatically in increments which are steplessly variable from 0·0008 to 0·0024 in. per revolution of the work. A shaft to be ground is supported on a centre in the vertical driving spindle of the workhead, which can be adjusted manually on the column by rack and pinion, and clamped in any required position. The spindle of the workhead is driven at a fixed speed of 45 r.p.m. by a small motor at one side of the head, through a worm reduction gear. Near the upper end, the shaft is supported in a three-pad steady, one of the pads being carried

serrated type of driving belt. The need for keys and key-ways in the assembly of the pulley to the shaft is thus avoided. Most spindles are heat-treated prior to finishing and all bearing diameters, also the flanks of driving worms, and threaded portions, are finish ground.

Other grinding machines installed in the shop include Schaudt (Burton, Griffiths & Co., Ltd.) cylindrical and universal types, and a Jung (Vaughan Associates, Ltd.) rotary surface grinder, in addition to Japanese-built machines. An example of the latter is the Toyoda-Gendron centre-hole grinding machine shown in Fig. 5, which is employed for finishing centre holes in heat-treated shafts in preparation for grinding between centres. Made under licence in Japan by the Toyoda Machine Works, Ltd. (MACHINERY, 97/652—21/9/60), this machine will accept shafts up to 11 in. diameter by 39·4 in. long, and is fitted with a grinding wheel of 0·78 in. nominal diameter which is driven by a 1-h.p. motor through a belt at a speed of 7,800 r.p.m.

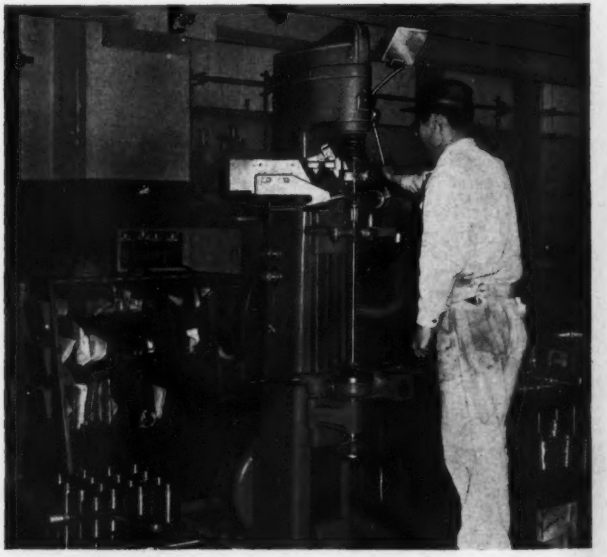


Fig. 5. This Toyoda-Gendron machine, built under licence in Japan, is employed for grinding the centre holes in shafts, after heat treatment, in preparation for finish-grinding the bearing surfaces

on a pivoted arm, which can be swung aside for loading and unloading.

For dressing of the wheel to the required angle, automatically, there is an attachment near the top of the column, which incorporates a slide with a diamond holder, spring-loaded towards the wheel. The spindle quill has a mounting for a cam with a straight edge, the angle of which can be set with the aid of a scale. As the spindle is fed down, the diamond is moved radially outwards to reproduce the angle of the cam on the wheel. Adjustments to the position of the diamond, relative to the wheel, are made by means of a knurled screw. A flexible duct, connected to a dust-extraction unit, is fitted with the open end near the grinding position to remove any abrasive thrown off during the dressing or grinding operations.

Some 15 lathes are provided in the machine shop. They include a Herbert No. 7A turret lathe for the production of spindles, and Japanese-built lathes from the Cazeneuve (Shoun Machine Tool Co., Ltd., Osaka) and Oerlikon (Mitsubishi Shipbuilding & Engineering Co., Ltd., Hiroshima) ranges. Of the European-built lathes, the newest is the H.E.B. (Drummond Asquith, Ltd.), type S, Pilote hydraulic copying machine shown in Fig. 6, which is also employed for turning shafts and spindles. It is seen set up for operations on a cutter grinder spindle which is machined from C 25 chrome-molybdenum steel bar, that is previously cut off to length and centred. During the 2-min. cycle, three cuts are taken along the portion of the shaft that projects from the work-driver, with the copying slide at the rear, at a spindle speed of 315 r.p.m. and a feed rate of 0·0075 in. per rev.

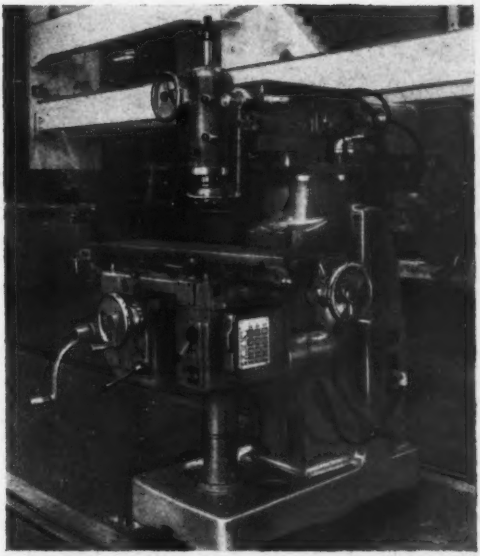


Fig. 7. The KGP-55, turret-type vertical milling machine from the Makino range has a table measuring 42 by 9·5 in., and eight spindle speeds from 130 to 2,200 r.p.m., selected by a dial

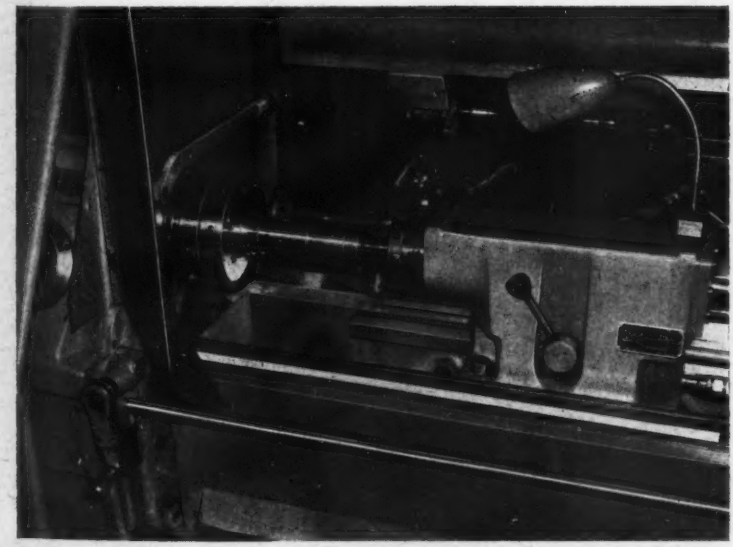


Fig. 6. This H.E.B., type S, Pilote hydraulic copy-turning lathe, is employed for rough-turning operations on shafts and spindles

Drilling machines, milling machines from the company's range and other Japanese builders, and some miscellaneous units made up the total of 67 machine tools installed in the factory at the time of our visit, but the number has almost certainly been increased during recent months. There is also a standards room containing such equipment as length and angle measuring

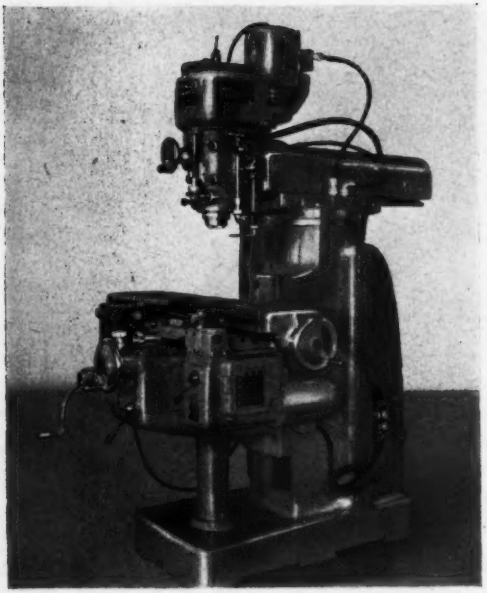


Fig. 8. With the same general dimensions as that shown in Fig. 7, this machine has a spindle driven through a 5-step V-pulley arrangement, and is equipped with standard scales and optical reading systems for use as a jig borer. A wide range of auxiliary attachments is available

machines, projectors, gear and vibration testers, and units for dynamic balancing and hardness testing. Approximately 30 per cent of the components for Makino machines are made outside the factory under sub-contract arrangements.

MAKINO MACHINE TOOLS

The most versatile and highly-developed machine in the company's range is the turret type vertical milling machine, of which 209 were built in 1959. One version of this machine, designated KGP-55, or No. 1 size, is shown in Fig. 7, where part of the assembly area is seen in the background, and it is intended for toolroom or production applications. The machine has a table measuring 42 by 9·5 in., with movement of 21·6 by 9·8 by 13·8 in., and the vertical travel of the spindle is 3·15 in. Drive to the spindle is taken from a 3-h.p. motor housed in the rear end of the over-arm, through a gearbox which provides eight speeds from 130 to 2,200 r.p.m., selected by a dial on the far side.

Provision is made for swivelling the casting which carries the over-arm, about a vertical axis, and for turning the spindle head in a vertical plane to any desired angles, as indicated on engraved scales, by means of crank-operated worm drives. Feed to the table, from a ½-h.p. motor mounted on the column side of the knee, can be varied in 12 steps, from 50 to 1,250 mm. (1·96 to 50 in.) per min., by pick-off gears, and the drive to the knee-elevating screw, from the handle at the left, is taken through a ball nut to reduce the manual effort required. A single, directional lever controls the power feed to the table, and other levers are provided for locking the table, knee, saddle, and spindle quill. This machine sells for slightly more than £2,000 in Japan.

TURRET-TYPE VERTICAL JIG-BORING AND MILLING MACHINES

Variations of the machine shown in Fig. 7, include the turret-type design in Fig. 8, which is designated KJP-55, and has the same general dimensions. Intended for production jig boring and precision milling operations, this machine is equipped with a spindle head which incorporates a mounting for the 1/0·6-h.p. pole-changing motor. Drive is taken through 5-step cone pulleys and V-belts which provide 10 speeds, from 225 to 4,000 r.p.m., in conjunction with the 2-speed motor. Table feeds are the same as those previously quoted, and the quill can be fed down at either 0·002 or 0·006 in. per rev.

Standard engraved scales, 10 and 18 in. long, for the transverse and longitudinal movements of the table respectively, are fitted to the far side of the knee and the table, and are read through magnifying optical systems which project images of the graduations on screens. With this system, supplied by the Japan Optical Industry Co., Ltd., it is claimed that the table can be positioned to very close limits of accuracy. The machine can also be supplied with a hydraulic tracing valve for copy die-sinking operations. A hydraulic cylinder in the tracing unit is coupled to a rack and pinion arrangement whereby the movements of the cylinder ram are transmitted to the spindle quill.

Other equipment or attachments enable the machine to be converted for such operations as slotting or key-way cutting, and jig grinding, with a spindle which has an adjustable planetary movement. Rotary tables, indexing attachments, vices, collet chucks, boring heads, and a centring microscope are also available.

The machine has also been built—and was exhibited at the Tokyo International Trade Fair in

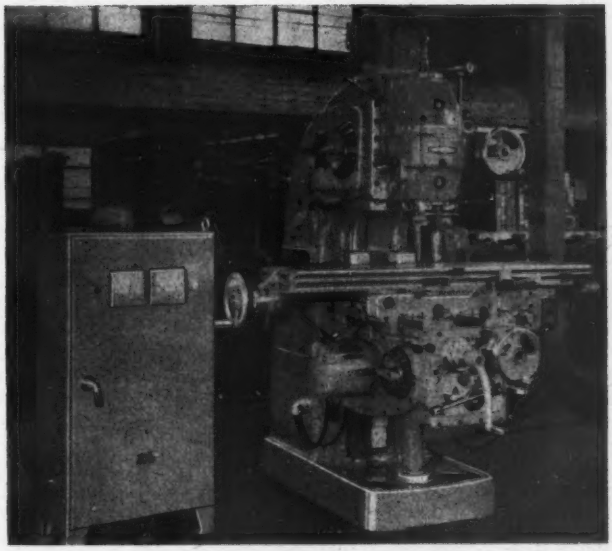


Fig. 9. This type MF-70 vertical milling machine, of conventional design, has 16 spindle speeds from 37 to 2,200 r.p.m., and a similar number of feed rates, all selected with the aid of dials on the spindle head and knee

1959—with equipment for magnetic tape control, supplied by the Fuji Tsushinki Manufacturing Co., Ltd. Tokyo. Basically similar to that shown in Fig. 8, the tape-controlled machine is fitted with hydraulic cylinders for the longitudinal and transverse movements of the table and saddle, and vertical movements of the knee. Pressure oil is supplied to these cylinders through servo valves, controlled from the magnetic tape.

Movements of the machine elements are monitored by position transducers, the outputs of which are fed back to the servo systems. The magnetic tape employed is ½ in. wide, and has seven tracks, of which six serve for controlling travel in each direction on the three machine axes. The remaining track carries instructions for spindle speeds, feeds, tool changing, and other data relating to the particular machining operation that is being performed.

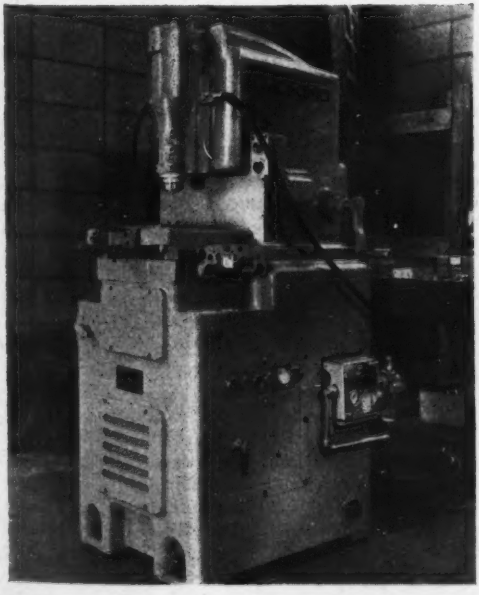


Fig. 10. Intended for use in the watch, clock, camera and instrument industries, for producing small parts with accurately-milled surfaces at various levels, this machine operates on an entirely automatic, cam-controlled cycle

MAKINO VERTICAL MILLING MACHINE

The latest version of the conventional vertical milling machine made by the company is the type MF-70 shown in Fig. 9, which is equipped for operation on an automatic cycle. This machine has a table measuring 4 ft. 6 in. by 11·8 in., with movements of 27·5, 11·8 and 13·8 in., longitudinally, transversely and vertically, and the spindle quill has a vertical movement of 3·9 in. A 7½-h.p. motor drives the spindle through gears, and any of 16 speeds from 37 to 2,200 r.p.m. can be selected on a dial. A similar number of feed rates is also provided, ranging from 0·6 to 60 in. per min. for the horizontal movements of the table in each direction, and from 0·24 to 23.6 in. per min. for the feed of the knee and of the spindle quill in the vertical direction.

Quick traverse at 11·5 and 4·5 ft. per min. is available for the horizontal and vertical movements

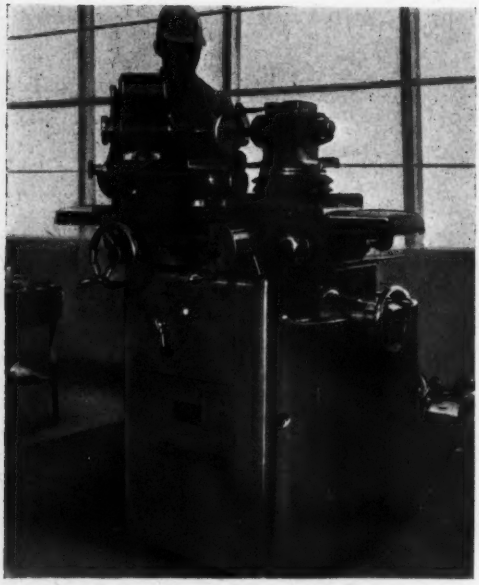


Fig. 11. The larger of two sizes, this type 2C universal tool and cutter grinder has a capacity of 10 in. diameter by 27 in. long between centres, and can be supplied with a variety of attachments

respectively, power for all the feed motions being derived from a 2-h.p. motor.

A single lever gives directional control of the table movements, and provision can be made, when operating on an automatic cycle, for retraction of the cutter at the end of a milling pass, before the table is returned under quick traverse for unloading. Oil is circulated under pressure to the gear trains, and there is a one-shot lubricating system for the ways on which the table is supported.

SM-50 THREE-DIMENSIONAL AUTOMATIC MILLING MACHINE

Automatic vertical milling machines for operations on small components such as the bearing plates employed in the watch, clock, camera and instrument industries, are made in two sizes, of which the smaller is seen in Fig. 10 On this machine, the transverse and longitudinal movements of the table, through a distance of 1·96 in., and the vertical movements of the spindle head, through a maximum stroke of 0·98 in., are powered by cams. There is also an indexing stop ring, whereby the height of the cutter can be accurately set to any position within its range for milling surfaces at a maximum of 12 different levels during any one machine cycle. The camshaft is driven by a ¼-h.p. motor, at speeds from 14 to 120 sec. per rev., and it carries edge- and bell-type cams for the various movements.

A motor of 0·3 h.p. is mounted on the vertical slide, and carries a collet chuck for the cutter at the lower end of the spindle. This motor is driven through a frequency-changing unit, at speeds up to 12,000 r.p.m., to enable very small diameter cutters to be used, and is lubricated and cooled by means of an oil mist system. The larger machine is of similar layout and has a table measuring 13·8 by 6 in., with a movement of 6 in. in each direction. On this machine, the spindle head has a stroke of 3 in., will take cutters up to 0·39 in. shank diameter, and is directly driven at 3,000 to 6,000 r.p.m. by the ½-h.p. motor, supplied through a frequency-changer. A ¼-h.p. motor drives the camshaft, which can be run at speeds from 6 to 0·66 r.p.m.

Vertical milling machines of somewhat similar design to that shown in Fig. 10 are also made without the cam-controlled automatic cycle equipment, for more conventional applications. Such machines can be arranged for manual or power table feed, and can be supplied with optical positioning equipment for jig boring or high-accuracy milling.

TYPE 2C UNIVERSAL TOOL AND CUTTER GRINDER

Tool and cutter grinding machines were introduced as auxiliary equipment for milling machines, and the larger of the two sizes is shown in Fig. 11. In addition to tool grinding, the machine can be used for other toolroom work such as internal and external cylindrical grinding, also surface grinding. The table measures 3 ft. by 5·2 in., and has movements of 16 and 8 in. Workpieces up to 10 in. diameter can be swung over the table, and lengths up to 27 in. are admitted between the centres. The table can be swivelled up to 90 deg. in each direction, and is carried on combined roller and ball bearing ways to ensure smooth and easy movement. Controls for the table are duplicated at the rear of the machine.

Carried in cartridge-type, pre-loaded bearings, the wheel spindle can be driven at 3,850 or 5,735 r.p.m., by the ¾-h.p. motor. The head can be turned through 360 deg., and has vertical adjustment of 7½ in. A wide variety of attachments is provided for the machine, for example, for grinding long reamers, large face mills, and optical laps, for wet grinding, and for grinding radii, as shown in Fig. 11. The smaller machine has a capacity for work up to 7 in. diameter by 16 in. long between centres.

DIE CASTING SUPPLEMENT

Production of Die Cast Models

The Practice of Lesney Products & Co., Ltd.

By H. K. BARTON

LESNEY PRODUCTS & CO., LTD., founded 13 years ago by Mr. J. W. Odell and Mr. L. C. Smith, began operations with a single die casting machine. Today, the company has more than 80 machines, most of which are automatic, in operation in their new factory at Hackney Wick, London, E.9. The plant, which is still being expanded, at present has a floor area of 110,000 sq. ft. In the die casting shop, improved, fully automatic machines, of the company's own design and construction, are being put into commission at the rate of two per month.

Lesney Products produce zinc alloy die castings under the Certification Scheme of the British Standards Institution, the current output being of the order of 2,000 tons per year. About 85 per cent of this tonnage is accounted for by the company's proprietary lines, such as the well-known Matchbox and Models of Yesteryear series, an example of the latter being shown in Fig. 1. Commercial die castings for industrial users form the remainder.

About 120 models are now included in the various ranges, and these are cast, finished, and assembled at the rate of 1,000,000 per week. To deal with this very large output, much specialized finishing and handling equipment has been designed and installed by the company. In addition to the die casting facilities, a battery of injection moulding machines is employed to produce such items as tyres, wheels, seats, and window assemblies. The Lesney organization is self-sufficient to a remarkable degree, for not only does the company manufacture the required dies, machines and processing equipment, but also has a construction department which is continually engaged in modifying and extending the buildings to meet the requirements of the expanding production departments.

The policy of the company is to limit production to zinc-alloy die castings weighing less than 1 lb., with the result that all the dies in operation are completely interchangeable, and any die can be set up on any one of the three types of machine in the foundry. This system permits a probably unparalleled flexibility of production both on jobbing and proprietary work.

THE THREE TYPES OF MACHINES

The simplest type of machine in the die casting shop, which now accounts for the smallest number, is a substantially standard D.C.M.T. manually-controlled unit. New dies being put into commission are run-in on these machines as a rule, and are

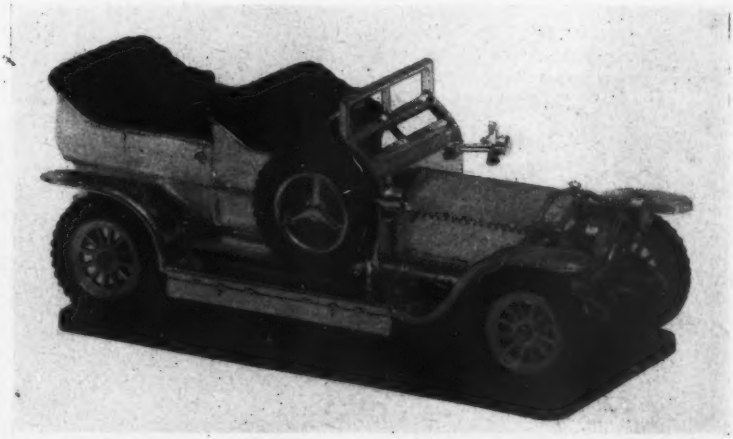


Fig. 1. The 1907 Rolls-Royce Silver Ghost, from the Lesney "Models of Yesteryear" series affords an indication of the meticulous detail of these die cast models

operated on them for trial periods to ascertain whether they are mechanically satisfactory. The main difference from the standard design, is that every die unit, which on these machines includes the toggle-locking mechanism, is fitted with four tie-bars instead of two, as seen in Fig. 2. This modification is essential for the maintenance of the very high standard of dimensional and mechanical precision that is built into the dies, and which has enabled the company to eliminate the trimming of flash—indeed, to eliminate the occurrence of flash—completely.

The second type of machine, shown in Fig. 3, is of basically identical construction, but has an air-actuated toggle-locking mechanism. These machines operate on a fully-automatic cycle, and are at present responsible for the bulk of the company's production of components for models. The average rate of production is of the order of 6,700 shots per 9-hour shift, and one operator can tend several machines since the cycle is arrested automatically if the casting sequence is interrupted for any reason, for example, if a casting remains "hung up" on the ejectors.

A third type, which is now increasingly replacing the second, is a fully-automatic air-actuated machine of larger size and more rugged construction, designed and built by Lesney Products. These machines, one of which is seen in Fig. 4, accept all the existing dies when they are stripped of the toggle mechanisms and mounted on standard cast-iron bolsters. The toggle-locking cylinders of the new machines have built-in hydraulic check circuits to obviate die slam while permitting fast die closure strokes, and the injection cylinders have been designed to give very fast die filling, with powerful final compacting pressure as filling of the die cavity is completed.

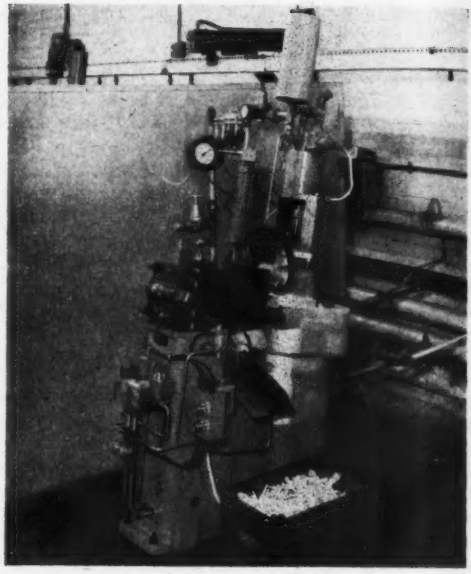


Fig. 3. Small, fully-automatic die casting machine of the type employed for producing models. Air operated toggle-locking mechanism is incorporated

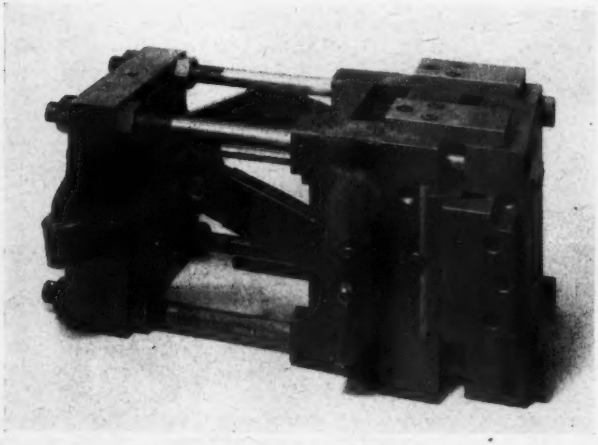


Fig. 2. A standard die unit removed from the machine. It will be noted that four tie-bars are provided

Both types of automatic machine are controlled by a simple mechanical cam system. Control units are housed in small cabinets adjacent to the machines from which they may readily be withdrawn for re-setting. The actual unit is extremely compact, as seen in Fig. 5, and weighs only about 30 lb. complete with the driving motor. It incorporates a step-pulley, speed-changing device, which provides for machine operation rates ranging from 4½ to 14½ cycles per min. Separate cams, locked to the spindle by a grub-screw, control die closure, injection, dwell for solidification, and die opening. A master cam, at the left-hand end of the spindle in the figure, allows the sequence to proceed only if each phase, in turn, is properly completed.

The dies used to produce the Lesney models have a wide diversity

of form and, in many instances, incorporate very ingenious mechanical features, some of which are described below. All, however, are characterized by extremely intricate and detailed cavity sinking and by a high level of dimensional precision. This precision is in part necessitated by assembly requirements, but is also rendered essential by the company's settled policy of eliminating trimming operations on models and commercial die castings alike.

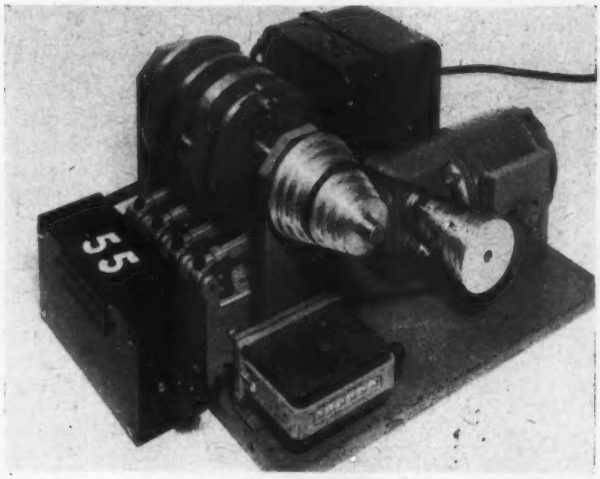


Fig. 5. Self-contained cam type control unit as employed for the automatic die casting machines

DIES FOR FLASH-FREE CASTING

To achieve flash-free castings, the bedding together of the die blocks, and the fit of sliding blocks in their housings, receive meticulous attention on the bench before a die goes into service, but much of the success of the policy is due to the initial design of the tools. Single-cavity dies are used for a large proportion of the parts produced, both the projected area of the shot, and the location of the cavity in relation to the pressure centre of the die, being carefully considered at the design stage with a view to preventing the occurrence of flash either as a result of unbalanced hydrostatic pressure as injection is completed, or because of thermal distortion as the die is heated to operating temperature. In passing, it may be mentioned that the mass of the die blocks is normally very large for the weight of metal injected, so that the die operating temperature is maintained without appreciable fluctuation once the correct value has been reached. The unvarying cycle time on the automatic machines also facilitates the maintenance of a steady temperature.

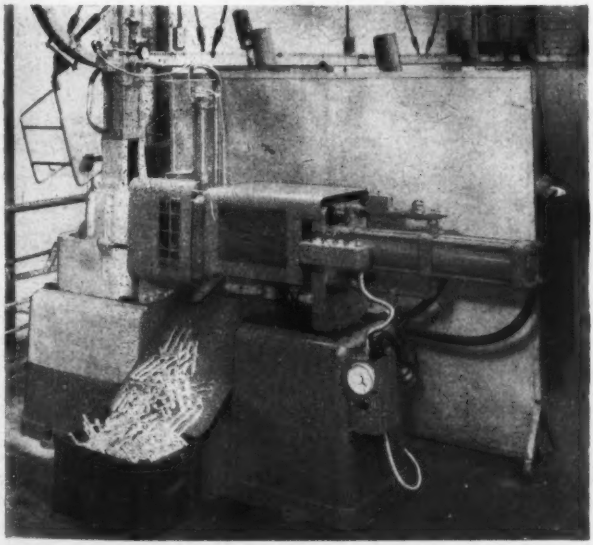


Fig. 4. Larger automatic machines, of Lesney design and construction, are now being installed at the rate of two per month

STANDARDIZED DIE FEATURES

A number of design features have been standardized for all Lesney dies. For example, it is the practice to provide spiral oilways on all ejectors, and the latter are frequently relieved to within a short distance of the working ends in order to minimize wear. In general, little use is made of distributors or sprue-pins. Typically, a small-diameter solid sprue is employed, which often abuts a sliding core-block. Where this arrangement is adopted, a projecting tongue on the face of the block forms an undercut which anchors the sprue-metal as

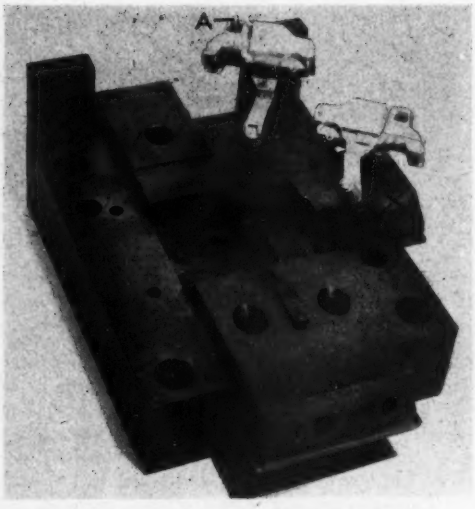


Fig. 6. In this die for a "wreck truck" model, the solid sprue is retained by a dovetail on the nearer core-slide

the die opens, and is retracted with the core prior to ejection. The tongue is normally of dovetail form, as in the die for the body of a Thames Trader "wreck truck" shown in Fig. 6.

This casting shows other features generally characteristic of Lesney dies. Attention is drawn, for example, to the avoidance of ejectors bearing directly upon the casting and the provision, instead, of lugs gated to the cavity edges or placed within internal openings, as at A. As will be observed, the lugs are several diameters in length. With these proportions two operational advantages are afforded. In the first place, a straight push-off is ensured, which can seldom be guaranteed with short lugs since they are liable to bend at the gates before the casting is clear of the cavity. Secondly, the length of the lug being only slightly less than the ejector stroke, the tips of the ejectors only project a short way from the cavity surface when they are fully advanced. Ejectors can therefore be placed at the rear of moving cores without the necessity of making provision for their retraction before the core moves in.

DIE FOR WHEELS WITH HELICAL RIBS

Another die of technical interest produces the set of wheels for the traction engine illustrated in Fig. 7. The two large wheels are ribbed, as on the full-size vehicle, and resemble a pair of shallow-toothed helical gears. The ribs are inclined in opposite directions on the two wheels. It will be evident that the wheels cannot be ejected squarely from the die, but must rotate through small angles, in opposite directions, during ejection. Provision is made for this apparently complex requirement in a very simple manner. For the two wheels in question, three ejectors are provided in line across the die. These ejectors are not mounted in a plate, but are individually spring-loaded so that they operate independently. The housings for these three pins are not at right angles to the face of the die, but are slightly skewed. The two outer pins are tilted upwards at a small angle, and the central pin is inclined downward. This latter pin bears on a projection from the main runner which is itself sunk at an angle into the die face, as indicated in Fig. 8. The outer ejectors bear on small lugs, skewed in the same direction as the housings, and each of these lugs has a transverse rib.

When the ejector mechanism operates, the effect of the pins moving forward along their respective axes is to displace the main runner laterally, through a fraction of an inch. At the same time, the outer lugs are displaced laterally in the opposite direction. The presence of the rib extensions prevents these lugs from rotating. In consequence,

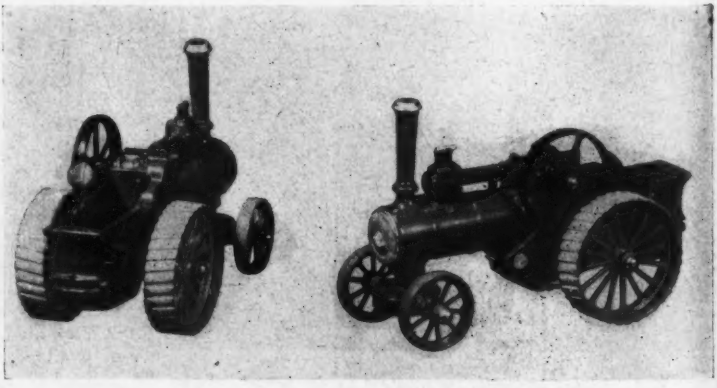


Fig. 7. Model traction engine with helically-ribbed road wheels

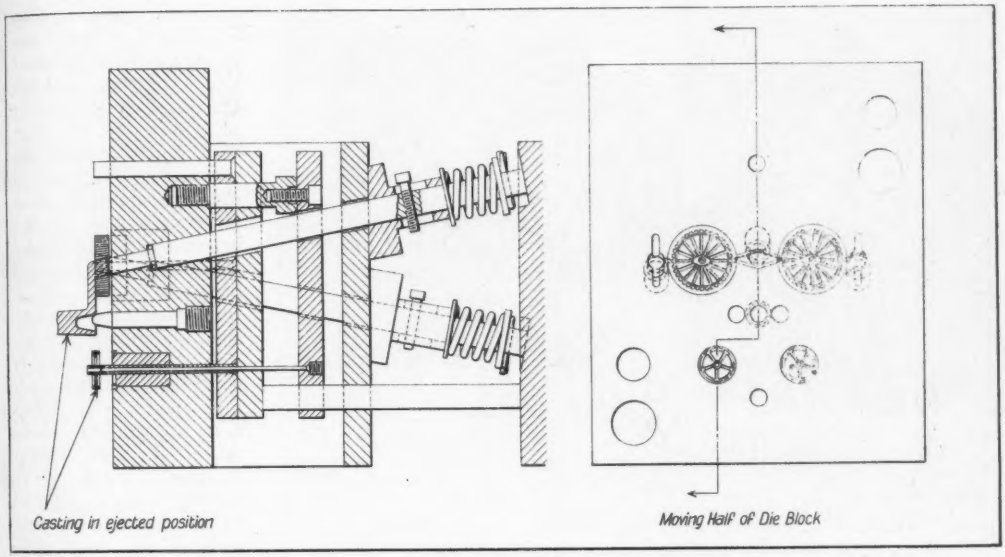


Fig. 8. The die in which the traction engine wheels are produced. A slight rotary motion is imparted to each wheel casting during the ejection phase of the cycle

each wheel casting is constrained to turn through a small angle as it is pushed from the cavity, and the two turn in opposite directions. Since the cavities for the other three wheels are shallower, the small lateral movement of the sprue does not in practice affect their ejection.

DIE FOR CAR TRANSPORTER MODEL

One of the largest single castings for the Lesney range of models is a car transporter body, two examples of which are shown in Fig. 9. This casting measures approximately 5⅛ in. by 1¼ in. by 1¼ in., and is of trough-like form with three openings in each side. The interior and the ribbed roof surface are formed by large opposed sliding cores, and there is a third core for the open end of the body, which is necessitated by the presence of the cross-member at *A*. A fourth—much smaller—core produces the slot *B*.

As may be seen, this casting is fed internally, being gated at an edge of one of the window openings. The sprue is solid and abuts on the upper sliding core. In this instance, however, the sprue is not anchored to the moving die assembly, its withdrawal from the sprue-hole being ensured merely by varying the taper on one side of

Fig. 9. The die for a car transporter body is here shown together with examples of the castings produced and a completed assembly

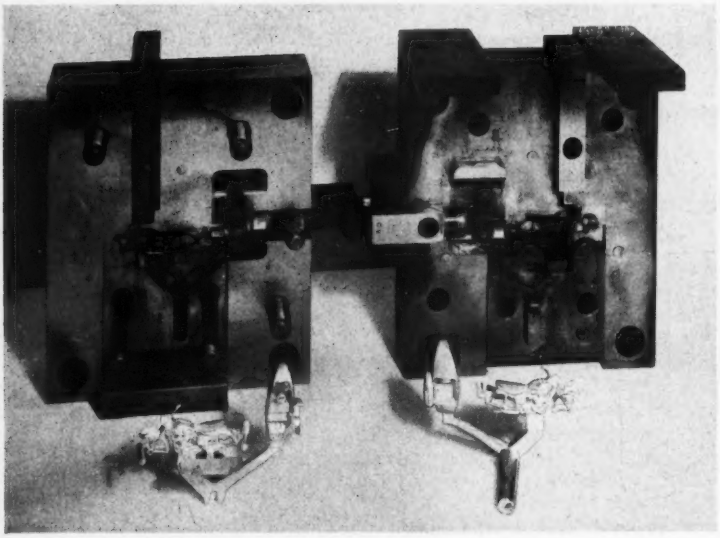


Fig. 10. This die for a Triumph T110 motor cycle and side-car model has produced more than 1,000,000 castings and is still in regular production

the hole, and by maintaining a high polish on the whole interior surface.

The casting is ejected by three pins only, which bear on stout lugs gated to the window openings. These lugs are larger in diameter than the ejector pins, and are well tapered to facilitate ejection. Being massive in comparison with the casting section, they also serve as effective overflow wells. On the sprue side of the casting, as will be observed, small overflows have been provided in the window openings to allow trapped air to escape from the cavity. Such overflows are added to many of the dies during development, and serve to eliminate the swirls that develop locally in castings of such thin section. Wall thickness of the models varies, but may be as little as 0·028 in. This die is six years old, has produced more than 2 million castings, and one million were made without any down time.

One of the most elegant dies is that for the Triumph T110 motor cycle and side-car. This die, which is shown in Fig. 10, is remarkable for the fidelity with which fine detail is reproduced and for the completely flash-free state of the castings. The elimination of flash is the more notable in view of the complex coring. One large core forms the under-side of the side-car support and the wheel arches, and a smaller, opposed, core forms the top of the headlamp and the handlebars. A third core, at right angles, forms the space beneath the mudguard of the side-car. Considerably more than a million castings had been taken from this die at the time when it was photographed, and this number was completed in a continuous run, without any down time for repairs or maintenance.

Although the majority of commercial die castings produced by the company are much heavier and of thicker section than the models, they too are cast free from flash. This statement applies even to castings as heavy as the Ford boot hinges seen in Fig. 11—cast in pairs which weigh 9 oz.

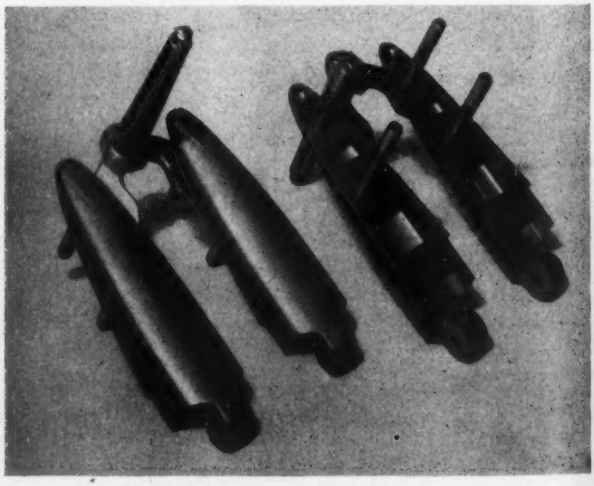


Fig. 11. . Die castings for Ford boot hinges, with steel stud inserts

as they come from the die. The hinge members, each of which has two threaded steel stud inserts, are produced on one of the larger machines of the company's own construction, to which reference has already been made. For these components, the machine is set for single-cycle operation. Inserts are placed in the die by hand, and to minimize lost time, the machine is tended by two operators, each of whom loads one cavity of the die.

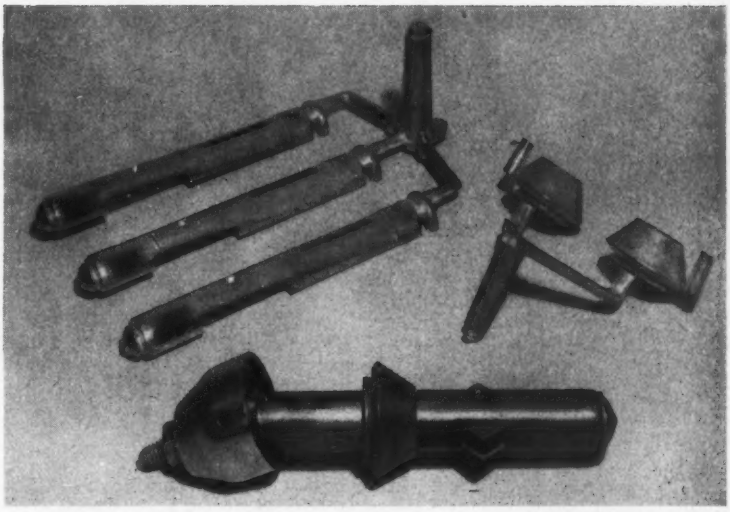


Fig. 13. Textile machine components are here shown in the "as-cast" condition (above) and in the assembled condition (below)

FACTORS AFFECTING FINISH AND ACCURACY

Despite the use of light gates and a minimum of overflows, and virtual absence of flash, a good quality "hardware finish" is consistently maintained on these and other commercial die castings. In this connection, attention is drawn to Fig. 12, which shows a bracket casting for a record player which weighs 4 oz. and has a mean section thickness of 0·040 in. As regards this aspect of design, the company's practice demonstrates that the usual procedure of providing heavy gates, large overflows, and extensive flash areas, in order to attain good surface finish, is by no means the only method for the achievement of this objective.

The main reason for designing for a heavy flash in normal practice, is to improve venting and ensure that the air is expelled from the cavity as completely as possible, but flash immediately adjacent to the cavity edges is often—especially in U.S. practice—deliberately thickened to provide for complete peripheral location of the casting in the trimming die. Since Lesney Products avoid die-trimming, the latter point loses its validity, and it is questionable to what extent a heavy flash sheet does, in the long run, facilitate the escape of air.

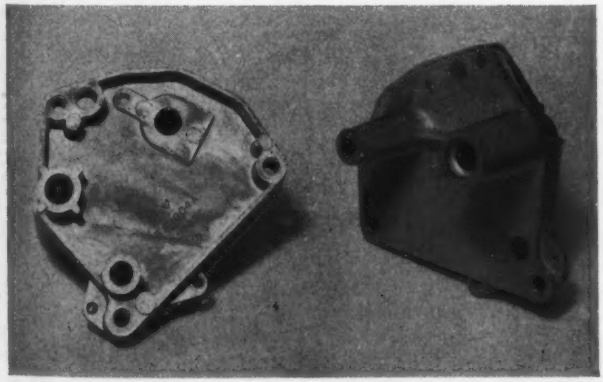


Fig. 12. This zinc alloy bracket for a record player affords an indication of the good finish obtained on castings

Although venting may be improved for the first few dozen shots, metal debris and lubricant residues soon build up on the die face beyond the flash area, so that the free escape of air is again impeded. Indeed, the deliberate provision for a flash sheet is often merely making a virtue of necessity, for when relatively small parts are produced in multi-cavity dies on large machines, it is exceedingly difficult to cast them without flash.

The good results obtained in combining flash-free casting with a high-quality finish can probably be attributed to several concurring

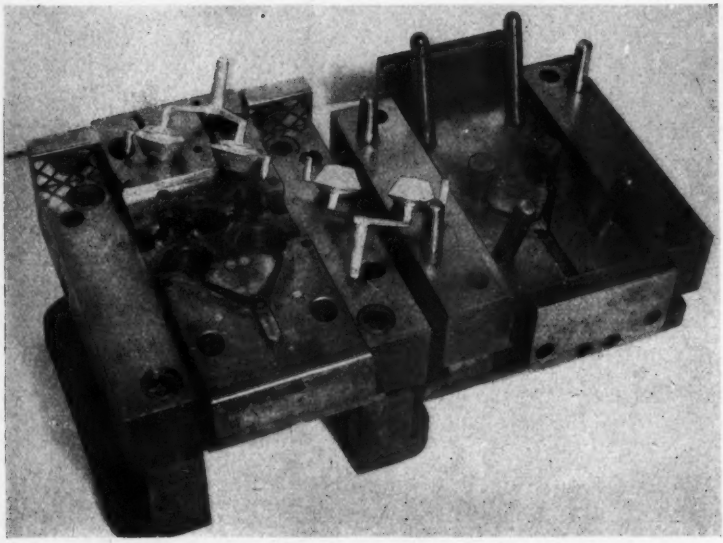


Fig. 14. The die in which the retaining rings for the textile machine components in Fig. 13 are produced

factors. The close bedding of the dies allows only air—and not metal—to escape at the parting, and there is no build-up of debris on the face. Predominant use of single-cavity dies, with small sprues and runners, reduces to a minimum the volume of air to be forced out of the impression ahead of the metal. Use of high filling velocities makes it possible to provide relatively light gates, and the under-loading of the machines—which have locking forces very greatly in excess of the hydraulic shock-loads generated by the terminal plunger thrusts—prevents the die blocks from being forced apart by metal pressure. Moreover, the standard design of ejector provides much better venting than is obtained with the plain ejectors generally in use in the trade.

All these factors, of course, promote the maintenance of close dimensional accuracy as well as good finish, as exemplified by the textile machine components in Fig. 13. Each assembly consists of two identical semi-circular shells, which lock loosely together by means of integral dowels and are retained in position by slipping on a ring, also seen in the figure. The dimensions of the shells—which would normally be expected to show some ovality—are held as-cast to such close limits that when assembled they are a slide fit in the ring.

USE OF FIXED CORES IN STATIONARY DIE MEMBERS

The manner of casting the rings is of interest, and the die in which they are produced is illustrated in Fig. 14. Each ring has an interrupted groove around the slotted collar, which—not being continuous—would be difficult to machine. There is, of course, no difficulty in incorporating this feature in the die casting, although the usual procedure would be to split the surfaces of revolution symmetrically between the die halves and to provide a sliding core to form the bore. This arrangement, however, would introduce the possibility of cross-parting ovality.

In the Lesney die, the critical conical surfaces of the two castings are formed in the ejector half of the tool without a split and the collar and groove are formed by a pair of opposed slides. The fixed cores for forming the bores are mounted in the stationary member, and the runners are carried up the shanks of the cores to the cavities. The sliding blocks thus form the tops of the cavities, and when the die is opened, serve to strip the castings from the cores. For this reason, only two ejectors are needed for the spray, since the conical castings shrink away from the cavity surfaces.

This practice of mounting a fixed core in the stationary die member, and stripping the casting on the opening stroke by using the side cores to retain it in the moving member, is frequently followed by the company's designers. The main advantage is that it reduces or eliminates the need for ejectors bearing on the casting. Another example is afforded by the die for a model car body —the Austin A 55—illustrated in Fig. 15.

Here, two opposed sliding cores, in the plane of the die parting, form the side details of the body and the window openings, and one of them carries, in addition, the dovetail peg or sprue retainer already described. Withdrawal of the side-cores is slightly delayed as the die opens, so that the casting is stripped from the core while still firmly held by the core faces. No special provision is made in the die for this delay, which is permitted by the company's normal practice of separating the function

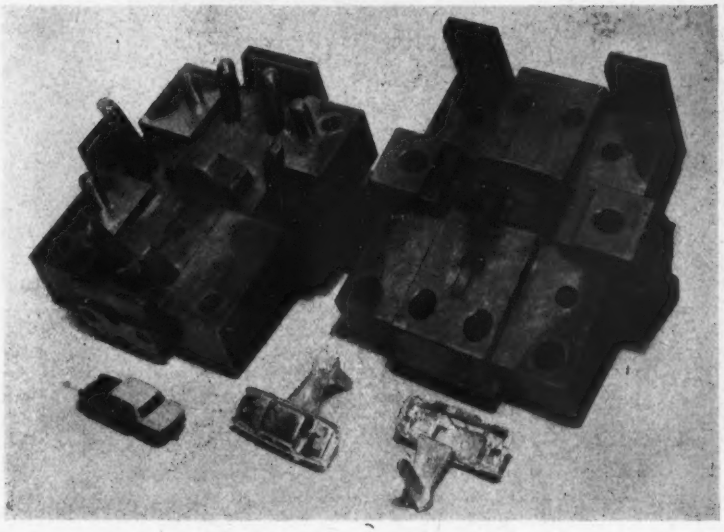


Fig. 15. In many car body dies, the main core is mounted in the fixed member, as here shown

of reciprocating the core slides from the function of retaining them in casting position during injection.

Core movement is accomplished in the conventional way by finger cams, often of the simple "angle pin" type, but clearance is provided in the housings in the slides. On the opening stroke, this clearance is not taken up until the dies have moved some way apart, and during this phase the casting is stripped from the fixed die half. The sliding blocks are held in position when the die is closed by wedge members on the fixed half, which engage bevels on the outer ends of the blocks. This procedure has the further advantages that the toggle mechanism is not required to provide simultaneously for stripping the casting and pulling the cores.

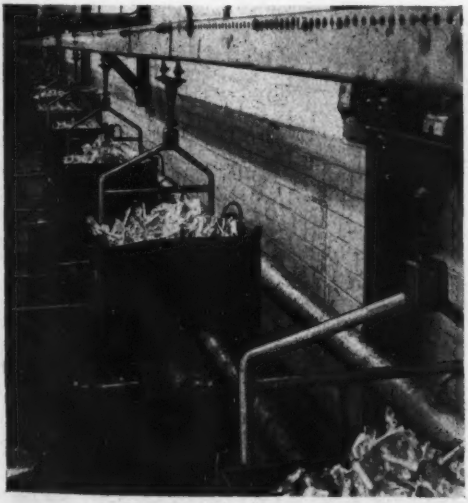


Fig. 16. Castings are transported from the machines to the barrel-tumbling installation by the conveyor system here shown

BARREL-TUMBLING TREATMENT

Almost invariably, dies are designed so that castings drop freely from the ejectors, but an air blast is sometimes provided to expedite discharge. The castings slide into small pans, and are transferred in batches to a barrel-tumbling installation by the conveyor system seen in Fig. 16. Mixed loads of castings are self-burnished—no chips or liquid being found necessary—for 10 to 12 min. This treatment is sufficient to knock off all runners, overflows, and ejector lugs, and to remove the very light burrs present on some parts. The mixed loads of castings are next tipped out on to moving conveyor belts extending across the shop, as seen in Fig. 17, where the components for the different models are sorted by lines of female workers. Scrap metal passes on along the conveyor to be returned for remelting. Each of the women stationed along the belt is responsible for picking out the various die cast components for one or more designated assemblies.

PAINT SPRAYING PROCEDURES

Next, the sorted castings are routed through the required secondary operations. For models, these operations normally comprise degreasing, priming, and a variety of paint-spraying stages. Degreasing and priming are carried out by conventional

Fig. 17. Sorting castings on an endless belt. The scrap metal is discharged at the end and returned for re-melting

methods, but the high volume of production, and the large number of different colours required, have resulted in the development by the company of some interesting processing techniques. For the main spraying sequences, as required for vehicle bodies, the castings are processed in large batches, laid out on wire trays on a mesh conveyor moving at about 10 ft. per min. On this conveyor they are carried under multiple spraying heads which reciprocate transversely and apply the base colour. The sprayed castings then pass into a tunnel oven with a recirculating air system, where the paint is baked hard. For models with 2-tone finishes, the castings are masked for the application of the second colour.

On many models, very small areas must sometimes receive third or fourth colours. Such areas include, for example, grilles and tail-lights, which are finished, respectively, in silver and red. Application of the paint by spraying to such small, sharply-defined areas—which adds much to the verisimilitude of the models—is carried out at special stations. Each of these stations, one of which is shown in Fig. 18, consists of a table with a vertical rear panel with rectangular openings at the base. In each opening there is a masking plate which conforms to the contours of the rear or front of the model that is being processed. These plates are slidably mounted and spring-loaded, and the action of the operator in pushing a model into place against the plate forces the latter forward. This movement, in turn, actuates a spray nozzle directed at the unmasked areas, and paint of the required colour is deposited. The spray does not continue for the whole of the time that the plate is advanced, but is applied only momentarily. The timing is adjusted to give a paint film of the required thickness, without wastage. The operator, using both hands, can process two parts simultaneously at the rate of about 20 per min.

In addition to the large-batch processing installation described above, there is another, seen in Fig. 19, which incorporates a chain conveyor extending through a spray-booth and ovens. This conveyor is provided with vertical spindles to receive the work, and at the top of each spindle there is a die cast spider shaped to support the particular casting to be processed. The spindles

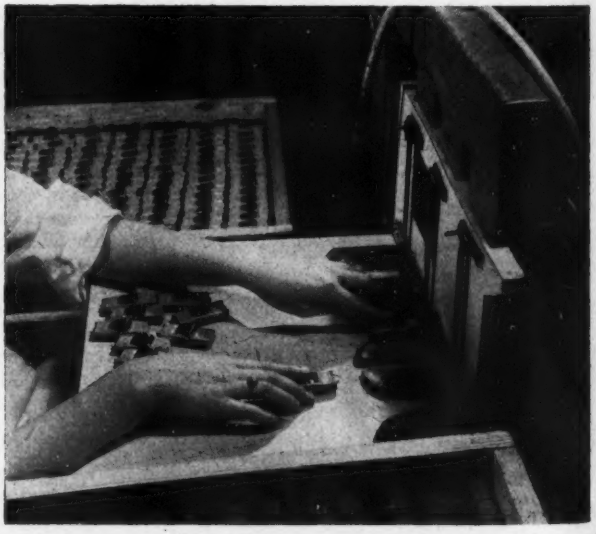


Fig. 18. Masking fixture for spraying small areas on models

are free to rotate, and as they enter the booth, a roller at the base of each contacts a friction surface. The casting is thus rotated as it passes through the spray zone, so that all exposed surfaces are covered.

After spray-painting has been carried out, transfers are applied to many of the models, especially of commercial vehicles. In some instances, as many as seven separate transfers are applied to a single model. Most of these transfers are of the standard type with a water-soluble adhesive, but some are mounted on a varnish base. To receive the transfers, models are loaded on to a moving belt, appropriately orientated, and female workers sitting at each side of the belt attach a single transfer to a particular model as it passes before them. Each transfer is slid to the edge of the previously wetted backing paper and the forward end is pressed with the index finger into contact with the model. The continued movement of the model pulls the transfer completely from the backing paper and leaves it correctly aligned on the model, and a stroking motion of the finger then completes the application.

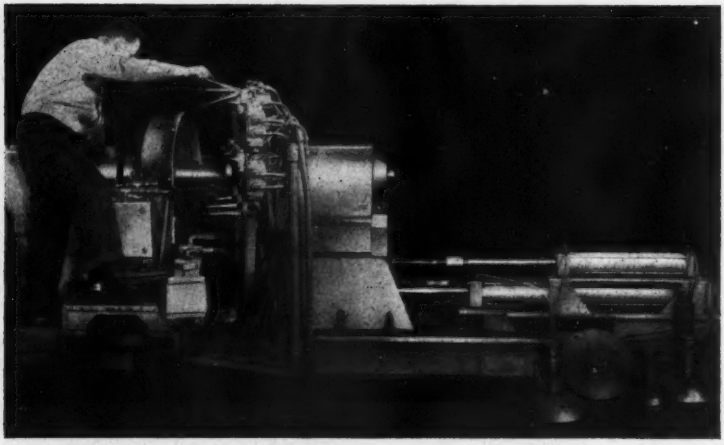
Fig. 19. Spraying installation with rotating spindles on which the die castings are mounted at the loading stations on the left

All Lesney models are supplied in individual cartons, into which they are loaded at the rate of more than 100 per min. per operator. The cartons are fed flat into a machine which opens them up, tucks in the lower flaps, and carries them forward, open end upwards, in front of the operator. She picks up the models, three at a time, and drops them into adjoining cartons. As the latter pass forward, the upper flaps are tucked in, and the packed models are discharged for transfer to the stores.

As already noted, current production is at the rate of 1,000,000 models per week, and because of their diversity it is necessary to maintain a stock of upwards of 10,000,000 in the storerooms—something of the order of 250 tons of die castings—in order to be able to fulfil orders for the whole current range. As new floor space is added to the plant, therefore, it is almost always taken over initially for storage. This procedure will apply, for example, to the 20,000 sq. ft. extension now nearing completion.

Despite the very large increase, during recent years, in the production of models, the company does not consider contract die casting production as in any way subsidiary. It is envisaged, however, that the present ratio between proprietary and jobbing production—with the former accounting for about 85 per cent of the total output—will, in general, be maintained, because it has been found to give maximum flexibility in production. As has already been noted, all dies are constructed so that they can be operated on any of the machines in the plant. Consequently, it is always possible to take off a die producing a model for stock and, within about 15 min., to put a die for a commercial casting into operation. Very quick delivery of contract work can thus be ensured.

With a ratio of 85/15 between proprietary and jobbing production, such unscheduled die changes can be made without substantially affecting the overall production of models, but any considerable departure from this ratio would tend either to impair the company's present ability to maintain representative stocks of the full range of proprietary items, or diminish their ability to put contract die castings into production at very short notice.



The Mecatorn Process of Metal-spinning

FOR MORE THAN 30 YEARS C. W. Torngren Co., Inc., Somerville, Mass., U.S.A., have specialized in metal spinning. Equipment installed for this purpose ranges from small lathes on which spinning is performed by hand, up to a large stand with a capacity for 16-ft. diameter blanks, and provided with portable pneumatic cylinders for powering the forming rolls. Of particular interest, however, are the machines used for the company's Mecatorn process.

These hydraulic-pneumatic machines are generally similar to the various commercially available shear-spinning or flow turning machines, apart from certain features.

One of the differences is that the Mecatorn machines provide for 3-axis tool movement. In addition, although the tools are completely power-operated, movement is under the direct control of the operator at all times. Tool pressure and rate of travel can be regulated by means of a bank of hand valves on the operator's console. Optimum conditions can thus be established for the first piece in a batch, and then repeated for each succeeding piece.

Another difference is that the process does not reduce blank thickness to any substantial extent. In consequence, it is possible with the Mecatorn machine to produce forms similar to those obtainable by hand spinning—for example, with sharp changes in direction and re-entrant curves.

Of the two sizes of machine in use, the No. 1 will accept blanks up to 4 ft. diameter, with a maximum thickness of ⅜ in. for stainless steel, and ¾ in. for aluminium.

For light work, air under a maximum pressure of 200 lb. per sq. in. is applied to a 10-in. diameter cylinder which applies the load to the spinning roll. If heavier work is to be performed, the air supply is cut off and hydraulic pressure at 1,000 lb. per sq. in. is applied.

On the No. 2 machine, shown in the heading illustration, power for the spinning roll is again provided either pneumatically, for light work, or hydraulically, for heavy work. The tailstock will exert a maximum thrust of 28,000 lb. and the machine will handle blanks up to 8 ft. diameter, with a maximum thickness of ⅜ in. that can be formed for stainless steel, and 1½ in. for aluminium.

Two tool carriers are mounted on the same carriage, one at the front of the machine and one at the rear. By bringing both rolls into contact with the work when spinning heavy-gauge material, pressure is equalized on opposite sides of the mandrel and headstock spindle.

Among the parts produced by this method are components for submarines. One example is a bulkhead penetrant seal ring of double reversed form. This component is required for a nuclear submarine power plant, and is supplied to Westinghouse Electric Corporation, Plant

Apparatus Division. It is produced from an 18-in. blank of cold-rolled and annealed Monel (QQ-N-281A), $\frac{7}{8}$ in. thick.

When work on this part was begun, the first four attempts ended in failure, due to defoliation of the material. It became necessary to obtain Monel alloy of spinning quality before it was possible to proceed.

Three spinning stages are needed to obtain final form, as shown in Fig. 1. All mandrels are made from blocks of mild steel, carburized and sand-blasted.

For the preforming stage, as seen at *A*, the pierced blank is located on a ¾-in. diameter mandrel pin. A tailstock-mounted follower is then brought into contact with the blank to hold it against the mandrel and prevent slipping. One tool is used for this breakdown operation, and the blank is rotated at 300 r.p.m. Although the main purpose of this stage is to prepare the work for the next, a portion of the blank is brought to the final contour.

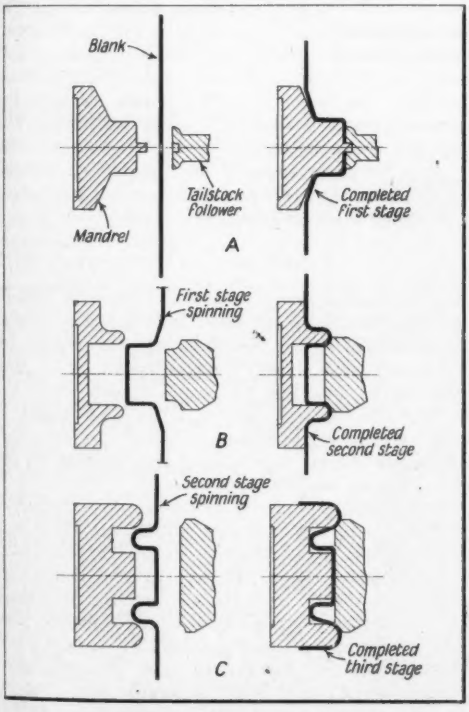


Fig. 1. Three stages are required to spin this bulkhead seal ring. The part is reversed for the second and again for the third stage

Fig. 2. A close-up view of the mandrel for the final spinning stage, at which the outer flange is reverse formed

For the second stage, shown at *B*, the work is reversed and the hub portion is inserted in the recess in the mandrel. At this set-up, a portion of the work which has already been spun is first re-worked to ensure a close fit on the mandrel, and the tailstock follower is then advanced and locked.

Two diametrically-opposed tools are employed for the second-stage reverse spinning on account of the heavy forces involved and the need to avoid excessive strain on the headstock spindle. If necessary, the tool positions can be adjusted individually to avoid "sombreroing" of the rim of the blank. At the completion of this stage, about 40 per cent more of the final form has been obtained.

At the third-stage set-up, as shown at *C* in Fig. 2, the spinning is again reversed. An internal boss on the mandrel, also seen in Fig. 3, now enters the rear of the workpiece hub while the U-shaped form is nested in the face of the mandrel. As at the previous stage, positive contact between the mandrel and the spinning is ensured by re-working a portion of the form before the tailstock follower is advanced. Reverse spinning at this final stage is carried out with a single roll which completes the contour.

Throughout the spinning operations a sulphur-free oil is used to provide lubrication between the roll and the work surface. Work hardening, as a

Fig. 3. While mounted on a lathe, thickness is checked ultrasonically at 144 points (twelve in each of twelve radial locations) around the spinning. It must not vary more than 0·003 in. per $\frac{1}{8}$ in.

result of spinning, is relieved by bright annealing, at 1,800 deg. F., in a sulphur-free atmosphere, after each stage. At the discretion of the operator, annealing may also be carried out at any intermediate stage. Cold water, to which denatured alcohol has been added, is employed for quenching. The alcohol helps to clean the parts, also to brighten them, and produce a faint copper tinge. A slight oxide film remains, which assists spinning on account of its lubricating properties.

Finally, the bulkhead seal is mounted on a lathe and skimming cuts are taken both internally and externally. It is then polished with 180-grit emery cloth which is applied dry.

While the seal is still in position on the lathe, an ultrasonic check is made with a Vidigage, as seen in Fig. 3, to determine the thickness. Tests are made at 144 points—12 points along the cross-section at each of 12 radial positions. The operator coats the surface with glycerine and then applies the probe to each check point individually. Thickness is strictly controlled to avoid stress concentrations in the finished seal.

Hard Surfacing Aluminium Cylinders by Flame Spraying

It is reported in *Metco News* that leading manufacturers of small petrol engines in the U.S.A. are obtaining considerable benefits from the use of the Metco process for spraying steel on to the bores of die cast aluminium alloy cylinders instead of fitting cast iron liners. The latter, which would be approximately ⅛-in. thick, are replaced by steel sprayed directly on to the cylinder walls by two type K Metco metallizing guns, which are push-button controlled. The initial bonding coat is of Sprabond wire, after which Sprasteel LS is applied. After the honing operation, a hard steel surface layer remains, which is only 0·007-in. thick.

In preparation for spraying, the castings are bored, degreased, and then grit blasted in the bores. It may be noted that the grit-blasting operation is carried out on a 2-station machine, with the work rotating at about 880 r.p.m. Immediately after it has been grit blasted, the work is loaded into a 6-station, horizontal spindle machine, for flame spraying, on which it is rotated at about 150 r.p.m. Stations 2 and 3 provide for preheating, the work being brought to a temperature of 400 deg. F. by gas flames which are directed on to the cooling fins. The object of heating is to expand the cylinder to its operating condition, thereby minimizing any stresses on the bond during service.

A flash-coating of Sprabond wire is applied at station 4, and the final coat of Sprasteel at station 5, the work being allowed to cool at station 6. In addition to the saving in cost and weight, an advantage results from the oil-retaining properties of the sprayed coating. It is stated that one company using this process produces more than 2,000 engines per day for use in lawn mowers, chain saws, pumps, and small generator sets. Metco Inc. are associated in this country with Metco, Ltd., Chobham, Woking, Surrey, who are registered users of the trade-marks Sprabond Wire and Sprasteel.

Russian Machine Tools at the Leipzig Fair

By R. E. GREEN, Associate Editor

Reference to some of the machine tools shown in the Russian pavilion at this year's Leipzig Spring Fair was made in MACHINERY, 98/1193—24/5/61. These machines included a large hydraulic copying lathe with provision for cycle selection by switches; a development of a standard centre lathe with equipment for automatic loading, unloading and copy-turning; a 6-spindle bar automatic; an automatic relieving lathe for hobs and milling cutters; and a vertical-spindle surface grinder. Other machines are here discussed, and subsequent articles will be concerned with two large in-line transfer machines, which were also shown.

SPIRAL BEVEL GEAR GENERATING MACHINE WITH AUTOMATIC LOADING

One of the exhibits in which Western visitors showed much interest was the type 525 automatic spiral bevel and hypoid gear generator seen in Fig. 1, which was provided with automatic loading and unloading equipment. Built by ENIMS, the Central Experimental Scientific Research Institute for Metal-working Machines, Moscow (see MACHINERY, 93/7—2/7/58 and 93/577—10/9/58), the machine can be employed for roughing and finishing operations on gears and pinions of the curved-tooth spiral bevel, curved-tooth bevel with zero spiral angle, and hypoid types. Gears up to 10 mm. module can be cut, with maximum cone distances of 260 mm. (10·25 in.), 215 mm. (8·5 in.), and 180 mm. (7 in.), for spiral angles of 30, 15, and 0 deg., respectively.

Maximum pitch diameters of gears range from 250 mm. (9·8 in.) for a ratio of 1:1 and 0 deg. spiral angle, to 500 mm. (19·68 in.) for a ratio of 10:1 and 30 deg. spiral angle. The maximum width of face is 2·56 in., and the number of teeth may range from 5 to 100. Cutter heads of 6, 7·5, 9 or 12 in. diameter can be employed, and the maximum radial offset of the cutter spindle axis is 240 mm. (9·5 in.). There are 12 cutter spindle speeds from 25 to 325 r.p.m., the drive being taken from a motor of 6 h.p., and there is a range of cutting times per tooth from 4·5 to 76 sec.

A new principle, it is stated, is incorporated in the design of the rolling mechanism. The generating and indexing motions are derived from continuously-meshing gears in the driving train, including a combined internal and external gear through which the rolling motion is transmitted to the cradle carrying the cutter spindle. This arrangement, it is claimed, ensures a rigid and continuously-maintained relationship between the rolling motion of the cradle and the rotation of the gear blank. During the idle motion of the cradle, a hydraulically-operated friction clutch is engaged to speed up the movement and thus effect a reduction of the lost time.

For roughing gears with large cone angles, the in-feed method can be employed whereby a slow

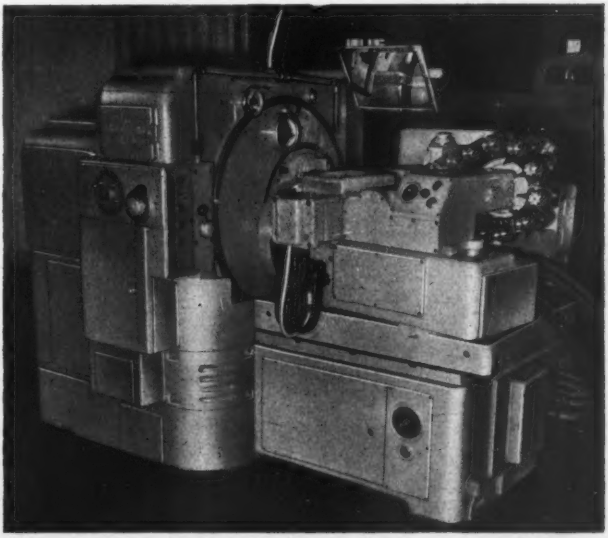


Fig. 1. Built by ENIMS, this type 525 spiral bevel and hypoid gear generator is fitted with automatic loading and unloading equipment

* Articles describing East German machine tool exhibits at the Leipzig Fair were published in MACHINERY, 98/939—26/4/61, 98/1006—3/5/61, 98/1074—10/5/61 and 98/1119—17/5/61.

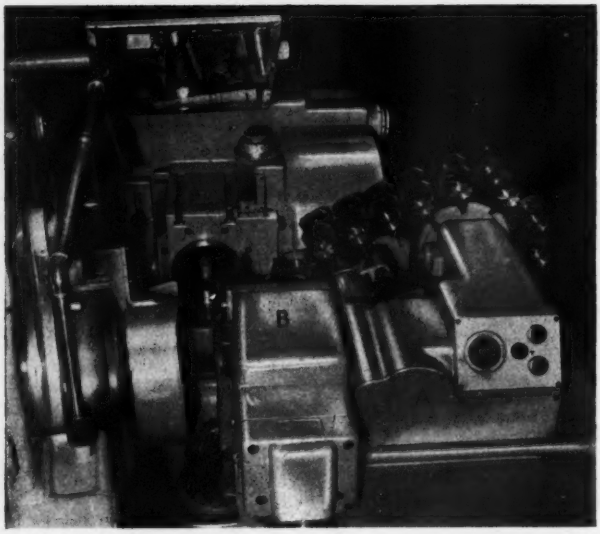


Fig. 2. Close-up view of the type 525 machine showing the automatic loading and unloading equipment which is designed for final drive pinions and has a cycle time of approximately 5 sec.

feed motion towards the cutter head is imparted to the base which carries the work-head. At the end of the cut, the work-head base is returned and the work spindle is indexed by one tooth space. After a workpiece has been loaded, and the machine started, all the teeth are completed in an automatic cycle. The number of teeth is counted as cutting proceeds, and the machine is stopped automatically when the operation has been completed. A built-in mechanism enables "formate" gears to be cut, also gears with large cone distances.

All the important gears in the transmission are hardened and ground, and the worm gearing for the generating motions of the cradle and the work spindle is made to a high degree of accuracy. Swarf falls into the base of the machine where it is directed into a trough in which there is a continuously-driven, twin-screw extractor, whereby it is discharged into a container at one side.

AUTOMATIC LOADING AND UNLOADING EQUIPMENT

A close-up view showing the hydraulically-operated automatic loading and unloading equipment for the rear axle pinions on which the machine was demonstrated, is given in Fig. 2. Mounted on the work-head base, the loading unit has two parallel spindles, of which the outer is at a higher level than the inner, and carries a drum of about 9 in. diameter. The other spindle has a roller chain sprocket, and a continuous roller chain passes over the sprocket and the drum. The roller chain is of special construction, with alternate plates which project outwards. Holes in these plates accept the turned shafts of the driving pinions, which are pushed in by hand.

By means of the mechanism within the housing *A*, Fig. 2, which contains the two shafts mentioned, the sprocket is indexed by an amount sufficient to bring one of the blanks into a position adjacent to the work spindle, and at the same level, as seen in the view from the opposite side, in Fig. 3. At

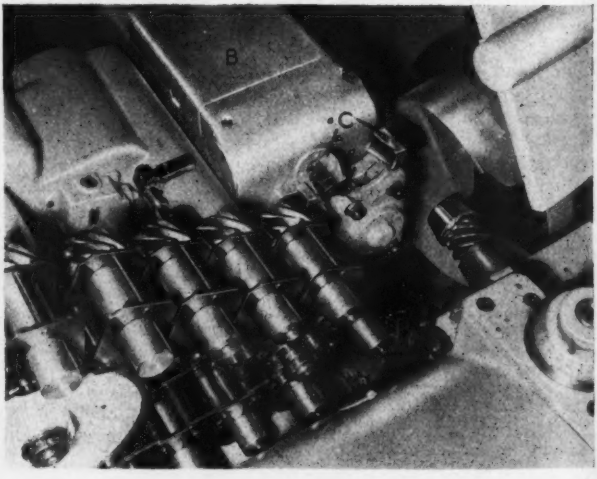


Fig. 3. In this view, from the opposite side to that of Fig. 2, can be seen the hydraulically-operated fingers, carrying shaped pads, whereby the finished pinion and the fresh blank are picked up during the unloading and loading cycle

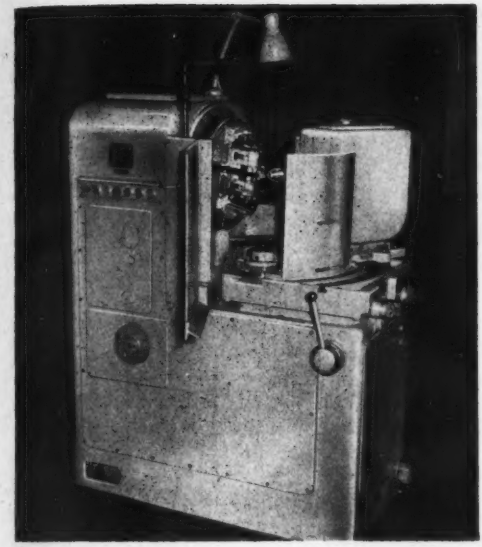


Fig. 4. The type 5P 23b gear generator is designed for cutting straight-tooth bevel gears up to 2·5 module and 20 deg. pressure angle. Work clamping and feeding are obtained hydraulically

the side of the housing for the indexing conveyor mechanism there is a second housing *B*, which contains a hydraulic cylinder whereby it can be moved in a direction parallel to the work-spindle axis. Within this housing there is a shaft carrying a hydraulically-operated mechanism incorporating two pairs of gripping fingers spaced at 180 deg.

One pair of fingers can be seen at *C* in Fig. 3, and each pair is fitted with pads so shaped that they will grip the heads of the workpieces both before and after the teeth have been cut. The shaft carrying the fingers can be indexed hydraulically through 90 deg. at a time, and when the fingers have been brought to positions opposite to the pinions in the work spindle and the magazine, the housing *B* is advanced and the fingers are closed on the pinion heads. Withdrawal of the housing then retracts the pinions from the work spindle and the magazine, after which the shaft carrying the fingers is indexed twice, through a total of 180 deg.

The housing is now advanced again, to insert the fresh blank into the work spindle and the finished pinion into the empty position in the magazine. Finally, the fingers are opened, the housing *B* is retracted, and the collet is closed on the new blank, in readiness for the next cycle. Subsequently, the shaft carrying the fingers is indexed through 90 deg., to the position shown, to avoid interference with the cutter guard as the work-head is fed to the right in Fig. 3. The complete automatic loading cycle that has been described occupies about 5 sec.

AUTOMATIC STRAIGHT-TOOTH BEVEL GEAR GENERATOR

Built at the Zaratov factory, the machine shown in Fig. 4, which is designated 5P 23b, has a capacity for cutting straight-tooth bevel gears up to 2·5 mm. module and 20 deg. pressure angle. Gear-type clutch members, with a profile angle of

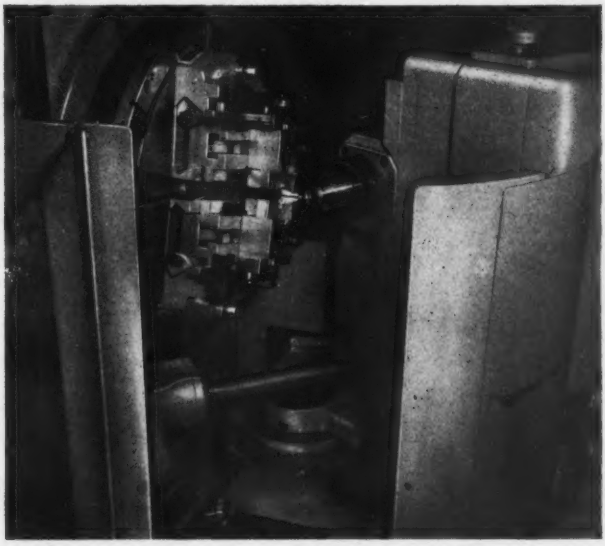


Fig. 5. A close-up view showing the cutters employed on the 5P 23b gear generator. For combined roughing and finishing operations, the generating and in-feed motions are engaged simultaneously during the first part of the cycle

20 deg., can also be cut. Gears with cone distances up to 2·56 in. can be produced, and the maximum pitch diameters at ratios of 10:1, 2:1, and 1:1, are 4·92, 4·33, and 3·54 in. The extreme ratio, with axes at 90 deg., is 10:1, the maximum face width and tooth height are 0·78 and 0·275 in. respectively, and the number of teeth may range from 10 to 200.

Drive from a motor of 2·25 h.p. is transmitted through a gearbox which gives a range of 16 tool speeds from 71 to 426 strokes per min. There is a choice of 11 feed rates, which provide for completing one tooth space in periods ranging from 2·15 to 21·5 sec. Hydraulic power for clamping the work, moving the work-head towards and away from the cutting position, and operating the rapid-traverse clutch, is provided by a pump driven by a 1·3-h.p. motor. Automatic loading and unloading equipment can be fitted, if required. The gears are produced by the generating method, by means of two heads carrying interlocking cutters, as shown in the close-up view in Fig. 5. When gears are cut from the solid without a roughing operation, the generating and in-feed motions are employed simultaneously during the first portion of the cycle. When the cutters have been fed to depth, the in-feed is stopped, and the remaining material is removed by the generating action only.

The rolling mechanism is similar in principle to that of the machine previously described, and a continuously-meshing gear train is again employed, with a combined internal and external gear through which the rolling motion is transmitted to the cradle. By the use of special cutters, gears with localized bearing may be produced, in addition to those with full length bearing surfaces. An electrically-driven pump supplies coolant to the work, and the machine is provided with a centralized, automatic lubricating system.

SPLINE HOBBING MACHINE

The type 5350 spline hobbing machine shown in Fig. 6, built at the Kuibyshev factory, can be supplied with four bed lengths to take work-pieces 29·5, 39·4, 59 and 78·75 in. long between centres, and the smallest size is illustrated. Components up to 19·68 in. diameter can be swung over the bed-ways, and splines or gear teeth up to 6 mm. module (4·2 d.p.) can be hobbed on diameters up to 5·9 in. The work can be held between centres, or in a collet chuck for diameters up to 3·9 in. or a jaw-type chuck for diameters up to 5·12 in. capacity. The minimum and maximum numbers of teeth that can be cut are normally 4 and 20, but the latter figure can be increased to 38, if required.

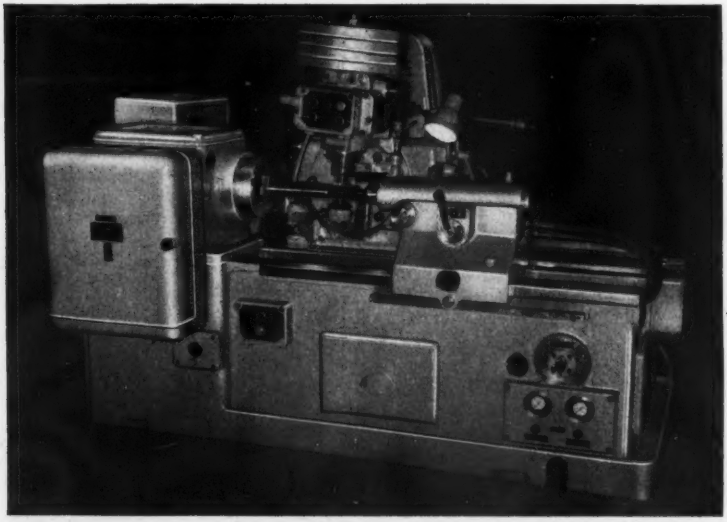


Fig. 6. Built at the Kuibyshev factory, the type 5350 spline hobbing machine is made with four bed lengths, and will cut splines and gears up to 6 mm. module

For the main drive, a 2-speed motor of 8·7/9 h.p. is employed, and six hob speeds, from 80 to 250 r.p.m., can be obtained by means of pick-off pulleys. To special order, this range can be increased to nine speeds, from 80 to 500 r.p.m. Change gears provide 11 feed rates for the hob spindle carriage, from 0·0315 to 0·197 in. per rev. of the work, and the carriage can also be rapid-traversed at 75·6 in. per min., by a motor of 3·75 h.p. A hydraulic pump, driven by a motor of 2·25 h.p., provides for the operation of the collet chuck, moving and clamping the tailstock quill, cross-traverse and clamping of the hob carriage, and operation of the feed clutch.

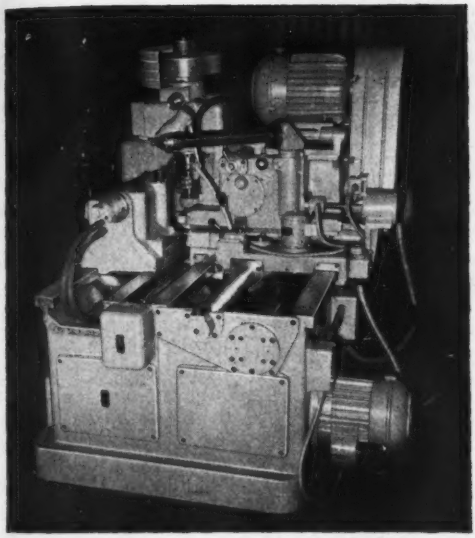


Fig. 7. This view of the type 5350 machine shows the guides for the tailstock and hobbing slide

Some further details of the machine can be seen in the view from the tailstock end, given in Fig. 7, and it will be observed that the bed is a one-piece casting with separate flat ways to carry the tailstock and the hobbing head saddle. Cross movements of the carriage on the saddle are obtained by means of a screw driven by a hydraulic motor, or by hand, through distances of 1·18 and 3·9 in. respectively, the spacing of the cutter and the work axes being variable from 1·57 and 5·5 in. The hob spindle housing can be moved axially through 1·96 in. by hand, and cutters up to 5·5 in. diameter by 4·13 in. long can be accommodated. There is provision for swivelling the hobbing head in the vertical plane through angles of 55 to the right and 70 deg. to the left, as viewed from the front of the machine.

A coolant pump and an automatic lubricating system, with separate electric motor drives, are provided as standard, and there is a wide range of accessories. Special equipment includes additional change pulleys and gears, also a set of change gears to enable spiral splines to be cut.

RADIAL DRILL WITH PROGRAMME CONTROL

The type 2H 57P shown in Fig. 8 is a product of the Odessa radial drilling machine works, and has a capacity for holes up to 2·95 in. diameter in mild steel.

Drive for raising and lowering the arm on the column sleeve, which is of 19·68 in. diameter, is taken from a motor of 3·75 h.p. through a ball-type safety clutch to a screw, and the arm is automatically clamped to the sleeve when the drive is switched off. Maximum and minimum distances from the spindle nose to the base-plate are 23·6 and 68·8. The 23- by 29·5-in. box table shown in position is 19·68 in. high.

Hand traverse is provided for the spindle head on the arm through 59 in. and the maximum and minimum distances from the spindle centre to the sleeve are 6 ft. 6 in. and 1 ft. 7 in. A steel strip forms the upper guide surface for the head, to reduce wear. Simultaneous clamping and unclamping of the spindle head to the arm, and the sleeve to the column, are obtained hydraulically under the control of two push-buttons at the centre of the traversing hand-wheel. Pressure oil for clamping is provided by a separate pump unit, driven by a motor of 0·67 h.p.

Of 4·13 in. diameter, with a No. 6 Morse taper bore, the spindle is carried in precision ball bearings, and is provided with a spring-type counterbalance. It has a vertical travel of 17·7 in., and there is a dial on the head on which the required

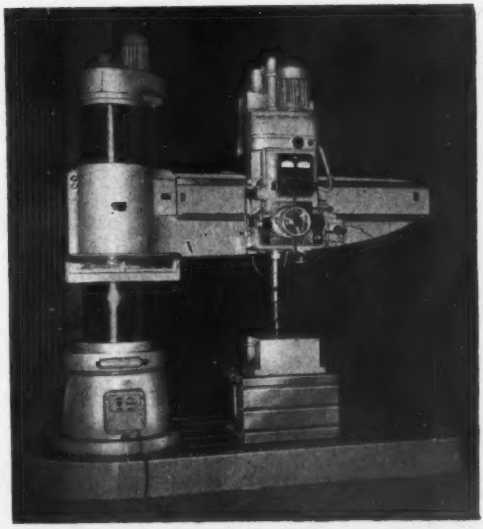


Fig. 8. Of 6-ft. 6-in. radius, this radial drilling machine, built by the Odessa factory, can be arranged for pre-selection of speeds and feeds, or fitted with equipment whereby changes are obtained automatically under the control of punched cards

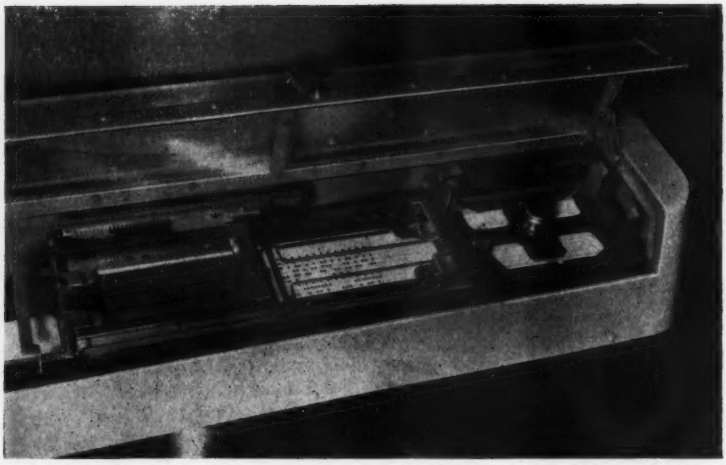


Fig. 9. Close-up view of the unit fitted to the column end of the arm on the radial drill in which cards, punched to correspond with the required speeds and feeds for various stages of the cycle are automatically read

travel can be pre-set, the feed then being disengaged when the required depth of hole has been reached.

The machine shown has been developed from the type 257 on which there is provision for hydraulic pre-selection of spindle speeds and feeds. There are 22 spindle speeds, ranging from 12·5 to 1,600 r.p.m., and 18 feeds from 0·0025 to 0·124 in. per rev., which are obtained from gearboxes in the upper and central portions of the spindle head respectively. The lower portion of the head houses the spindle feed mechanism, also a hydraulic pump and accumulator which provides pressure oil for gear-changing purposes.

Drive for the spindle is taken from a motor of 9·4 h.p., flange-mounted on top of the head, and the gears are of hardened and ground alloy steel. There is a safety friction clutch in the transmission, which prevents damage due to overloading, also a hydraulically-operated reversing clutch. The latter is used for threading operations, and is also arranged to slip when gear changes are being made. The cluster gears in the gearboxes are moved on splined shafts by means of hydraulic cylinders supplied from the pump and accumulator mentioned.

Pressure fluid from this accumulator is led to two multi-position valves in the left-hand side of the spindle head. The positions of these valves are set by means of two external hand-wheels on the pre-selection version of the machine, and the settings are then shown on two concentric dials at the front of the head. When the friction clutch is disengaged at the end of a drilling operation, the pre-selected speed and feed are automatically engaged.

On the machine shown, spindle speeds and feeds are selected in advance for each stage of an operation sequence, and are defined by means of a code of holes punched in rectangular cards of the type used in accounting machines. These cards are placed in a stack in the right-hand end of the automatic reading unit mounted on the column end of the arm, as shown in the close-up view in Fig. 9. After each drilling operation, the lowest card in the stack is automatically moved to the central reading position, and the hole code is electrically scanned. Signals thus generated serve to alter the settings of the speed and feed selection valves mentioned above, and the new values are shown in the dials at the front of the spindle head.

MILLING MACHINES

A variety of plain horizontal, universal, and vertical milling machines, with auxiliary equipment of various types, was shown, most of which were built by the Gorki milling machine factory. A typical machine is the type 6M 82 III which is shown in Fig. 10, and was also exhibited without the special overarm, as the 6M 82 design. It is built in plain and universal forms, and has a table with a working surface of 15·75 by 63 in., which can be swivelled through 45 deg. in each direction on the universal machines. Power is provided by a motor of 13·4 h.p., and the 18 spindle speeds, selected by the dial on the column side panel, range from 31·5 to 1,600 r.p.m., changes being made with the aid of a lever beneath the dial.

Movements of the dial are transmitted through bevel gearing to a selector disc within the housing, which has several concentric rows of holes. Opposite these holes there are pairs of selector rods, the movements of which are interlocked. Each rod is connected to a gear shifting fork, and these forks are engaged with grooves in the sliding cluster gears. When the lever is operated, the

disc is moved clear of the rod ends, and it can then be turned by means of the dial, which is set to the required spindle speed. The lever is then operated to return the disc, and the latter presses against the ends of all those rods which are not aligned with holes, moving them and the corresponding cluster gears to fresh positions to give the required ratios.

Changes of speed cannot be made with the spindle running, and an inching push-button is provided on the adjacent panel to facilitate changing. Other push-buttons on this panel, it may be noted, provide for starting and stopping the spindle drive, engaging rapid traverse, and switching the light on and off. All the spindle driving gears are of chromium alloy steel, and have heat-treated teeth. The shafts run on ball bearings, and there are three sets of bearings for the spindle, including a double-row roller bearing at the nose end, and two angular-contact ball bearings at the centre. Lubrication is provided by a plunger-type pump.

Selection from the range of 18 feeds, from 0·98 to 49 in. per min. for longitudinal and transverse movements of the table, and from 0·33 to 16·33 in. per min. for vertical movements of the knee, is made by means of a mechanism similar to that provided for speed selection. The selector dial is mounted at the left-hand side of the knee, and has a central push-button and knob instead of the disc-actuating lever mentioned above. Power is provided by a motor of 3·75 h.p., and there are three clutches in the drive to the feed gearbox, one of which is a safety ball-type unit. Another clutch, of the dog-type, is employed for the transmission of working feeds, and is interconnected with a magnetic clutch, operated by the push-button, whereby fast traverse is selected.

Rapid traverse of the table in the longitudinal and transverse directions is at the rate of 9·8 ft. per min., and of the knee in the vertical direction at 3·27 ft. per min. Selection of fast traverse in any direction automatically disengages the dog-type clutch for working feeds. Direction of movement of the machine elements is determined by two levers, one of which controls only longitudinal movements of the table. The other lever, seen just above the feed selector dial on the knee, controls transverse movement of the table and vertical movements of the knee in both directions. Both levers are directional, and the movements are interrupted when the levers are returned to the central positions.

The feed control lever for the knee and saddle is duplicated on the opposite side of the table to facilitate operation of the machine when end-milling and facing are being performed, and the table-traverse lever is also duplicated at one side of the saddle. Movements of the table, saddle and knee can be applied by hand, when required, a second hand-wheel for longitudinal movements of the table being fitted to the saddle, to avoid the need for standing at one end of the machine. Thrust bearings are provided at both ends of the table screw, and an anti-backlash unit is fitted to enable climb milling to be performed. The machine can be arranged to operate on a variety of automatic cycles under the control of six dogs in the T-slot in the front face of the table.

A hand-operated pump provides for lubrication of the feed mechanisms and the guide-ways of the table and saddle, and a second, plunger-type, pump automatically lubricates the knee guide-ways and the feed gearbox. There is a push-button station on the front face of the saddle from which spindle starting and stopping, table

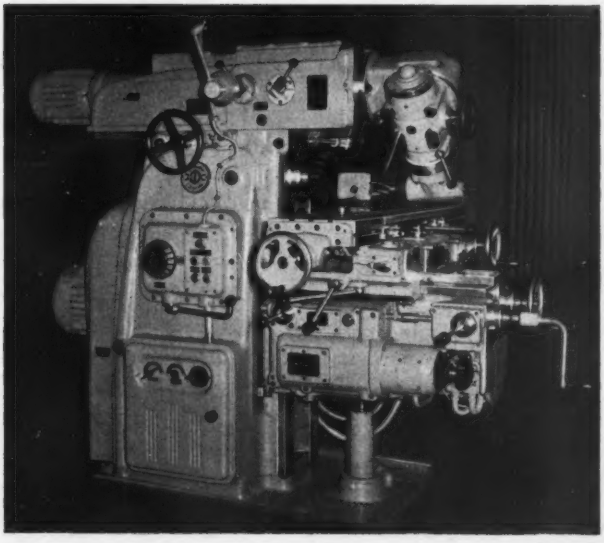


Fig. 10. Built by the Gorki milling machine factory, this type 6M 82 III horizontal machine is available in plain and universal forms, and can be fitted with a variety of attachments such as the special over-arm shown

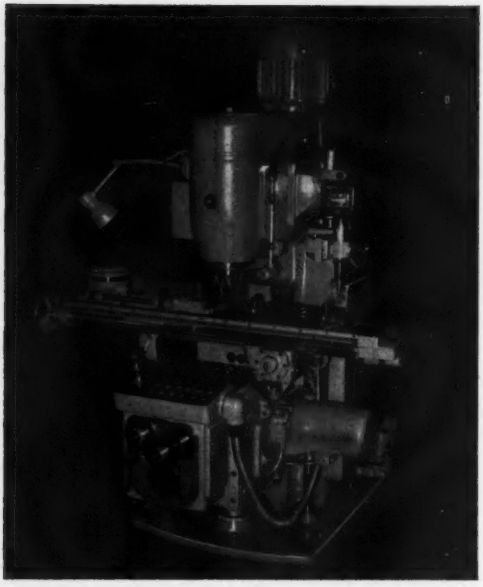


Fig. 11. This type 6H 11KP vertical milling machine, built by the Dimitrov machine works, Moscow, is fitted with electrically-operated copy-milling equipment and is also arranged for control of table movements by punched paper tape

operated gearbox whereby nine spindle speeds, from 90 to 1,400 r.p.m., can be selected. At the front end there is a spindle head which has movements in three planes.

VERTICAL COPY-MILLING MACHINE WITH PUNCHED TAPE PROGRAMME CONTROL

Vertical milling machines exhibited included the type 6M 12K, made by the Gorki factory, with provision for copying under electric tracer control, and a similar but larger machine—type 6M 13K—also arranged for copy-milling. Of particular interest was the type 6H 11KP machine shown in Fig. 11, which is built by the Dimitrov machine works, Moscow, and was equipped for copy-milling operations and for programme control by means of punched paper tape. The working surface of the table measures 9·8 by 39·37 in., and it has movements of 23·6, 7·87 and 13·78 in. in the longitudinal, transverse and vertical directions.

Drive to the spindle is provided by a 6 h.p. motor, the 16 speeds available ranging from 65 to 1,800 r.p.m., and for the 18 table feeds, from 0·78 to 39·4 in. per min. longitudinally and transversely, and from 0·39 to 19·7 in. per min. vertically, there is a separate motor of 2·25 h.p. Selection of both speeds and feeds is by dial, and rapid traverse at 9·8 ft. per min. is also available. The table screw is fitted with an anti-backlash arrangement, to permit climb milling.

rapid traverse, and stopping of the table feed motion can be controlled. A cavity in the base of the machine serves as a coolant reservoir, and an electrically-driven pump is installed.

On the machine shown, the overarm has been replaced by an auxiliary unit which enables a variety of angular milling operations to be performed. Drive is taken from a 3·75-h.p. motor, flange-mounted at the rear end, and the attachment has a lever-

Fig. 12. In this view of the type 6H 11KP machine can be seen the tape-reading unit at the side of the knee, which is driven from the feed gearbox, and the switch panel for selecting copy-milling or tape control

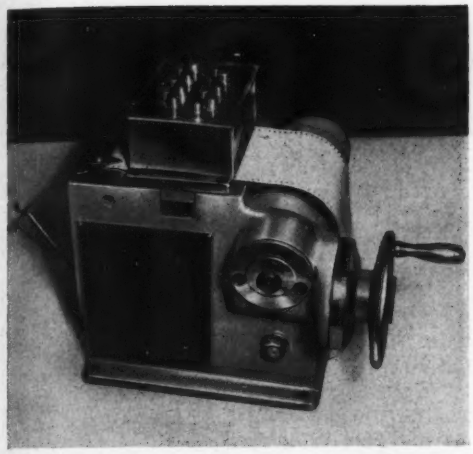


Fig. 13. For the preparation of paper tape to be used on the machine in Figs. 11 and 12, this simple punching unit is employed. Holes punched by the push buttons provide for table movements in three directions

On the machine exhibited, electrically-operated copy-milling equipment was provided in the form of a follower stylus carried in a bracket at the right-hand side of the head. Signals generated by this stylus serve to control the movements of the table in the vertical direction for such operations as mould and die cavity milling.

Other equipment fitted to the machine is designed to enable movements of the table to be controlled in the longitudinal, transverse and vertical directions by means of a punched paper tape, the reading unit being seen through the transparent window of the box at the left-hand side of the knee in Fig. 12. The paper tape employed is about 4 in. wide, with two rows of driving holes, and is prepared on the small punch unit seen in Fig. 13. This unit has a table at one side which shows the feed rates in the left-hand column, and a worm drive for a roll whereby the paper is fed past the punches at the top.

A handle for driving the worm is graduated in 150 divisions, each of which represents a distance of 0·2 mm. (0·0078 in.). The distance through which the table is to travel in any one direction is worked out in terms of revolutions of the worm-driving handle by reference to the table on the side of the punch unit, which provides for the different rates of feed in the horizontal and vertical directions. Holes are made in the tape merely by pushing down one of the 14 buttons on top of the unit, two of which are employed to start and stop the machine. The remaining three groups of four buttons provide for starting and stopping movements of the table in each of three directions.

For instance, one button is marked "to the right", and refers to a movement of the table in the longitudinal direction. The next button produces a hole which cancels this instruction. There are similar buttons for movements to the left, upwards and downwards, and forwards and backwards. The punched tape is inserted in the reading unit and is passed through a reading head by a mechanism driven from the feed gearbox. Electrical signals are transmitted from the head in accordance with the hole pattern in the tape, and serve to engage and disengage the table feed drive during the cycle.

The machine shown was equipped with a fixture for a forged component on which bosses were to be machined in three different positions. This forging was positioned in the nest-type fixture by V-locations, and clamped by the large-diameter air cylinder at the left in Fig. 11. Of the single-acting, short-stroke type, this cylinder has a ram which extends downwards and is connected by a lever to a shaft held in brackets at the front of the fixture. The shaft also carries a clamping lever at the right-hand end, whereby thrust is applied to the forging flange when the cylinder is actuated.

Further articles, to be published shortly, will describe two in-line transfer machines for operations on diesel engine bearing caps and oil filter housings, which were also shown in the Russian pavilion and attracted much attention.

ULTRASONIC INSPECTION OF WROUGHT IRON CONDUIT.—The Bristol Waterworks Company recently required to inspect the condition of wrought iron conduit which forms part of an aqueduct and was installed 115 years ago, and has received no maintenance other than painting. The conduit is of egg-shaped cross section, measuring 4 ft. 7½ in. high, by 3 ft. 6 in. at the widest point, and was constructed by riveting from plate of $\frac{7}{16}$ in. nominal thickness.

To enable inspection to be carried out conveniently, ultrasonic flaw detection equipment was hired from Kelvin Hughes (now part of Smiths Industrial Division) to measure the plates from the inside. Measurements carried out over a 110-yard section showed limited corrosion, the minimum thickness recorded being $\frac{5}{16}$ in. Spots selected for measurement were cleaned by wire brushing, and where the surface was rough, by grinding with a portable tool.

Wilkins & Mitchell Automatic-transfer Press Line

By S. C. POULSEN, Associate Editor

Fig. 1. General view of the automatic transfer line of five 600-ton Wilkins & Mitchell wheel-presses, at the works of Kelsey-Hayes Co. (Ford Motor Co., Ltd.)

The line of five 600-ton, type L.481-14 in., presses, shown in Fig. 1, which is integrated by the provision of automatic transfer equipment, to form a self-contained production unit, has been designed and built for Ford Motor Co., Ltd., Dagenham, by Wilkins & Mitchell, Ltd., Darlaston, South Staffs. This line is installed at the Dagenham works of the associated Kelsey-Hayes Co., and has a capacity of 720 pressings an hour. At present, the line is employed for the production of centre portions for Anglia wheels, in 10-s.w.g. mild steel, by the stages shown in Fig. 2. In view of the tonnage, however, and the fact that the maximum blank-diameter capacity is 18 in., it is probable that larger, heavier-gauge pressings, will be made in the future.

To ensure accurate alignment, the five presses are mounted on a continuous beam incorporated in the foundations, and they are arranged end-to-end, so that each is fully accessible from front and rear for tool changing, or for individual manual operation, if required. The centre-distance between the machines is 10 ft. 10 in., and the work is transferred from station to station, through apertures in the side-frames, by a series of six reciprocating slides. There is a loading slide, four inter-press slides, and an extractor slide, all of which are reciprocated by a single, centrally-situated drive motor, through an electro-magnetic clutch and brake. Each slide is provided with air-operated grippers, the jaws of which are spring loaded to accommodate variations in the work, and readily adjustable for components of different sizes.

To avoid the necessity for an excessively long transfer stroke, there is a total of 24 pairs of grippers, 19 of which are at idle stations, and the

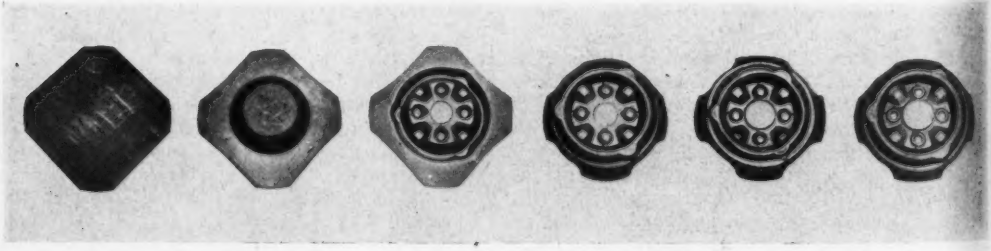


Fig. 2. Anglia car-wheel centres are produced on the press line by the stages here shown, from 10-s.w.g. mild steel blanks (left). The output capacity is 720 an hour

Fig. 3. Typical inter-press combined gripper and turn-over unit. These units are readily convertible to perform the gripping function only. A photo-cell is seen at *L*

transfer stroke is 26 in. Provision is made for inching the slides at one-tenth of the normal transfer speed, by means of a separate motor, for setting and checking, or re-starting after an emergency stop. For the set-up here considered, three of the paired grippers are arranged to serve, additionally, as turn-over units, as shown in Fig. 3. A maximum of four such units can be provided, to cater for different operation sequences on components of various designs, and they are readily convertible to perform the gripping function only, without the necessity for removing parts.

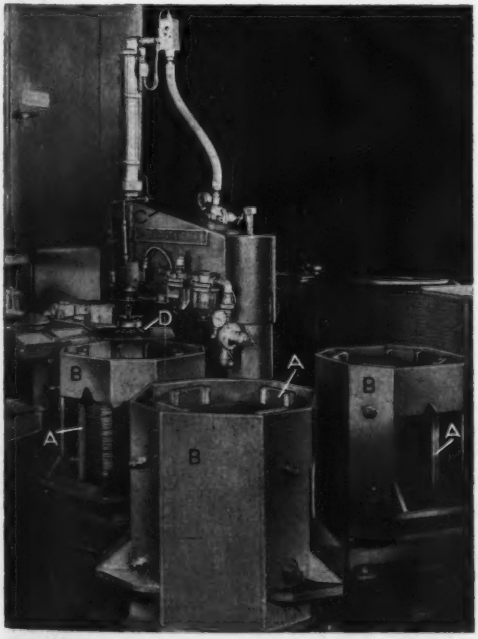


Fig. 4. The input end of the line, showing the air-operated lifting head *C*, and the 3-position indexing table which carries the removable magazines

At the input end of the line, shown in Fig. 4, the blanks are stored in removable magazines *A*, which are carried in the three holders *B*. These holders are mounted on a 120-deg. indexing table, which stops with one of the holders vertically below the air-operated lifting head *C*. This head, which is fitted with a vacuum cup *D*, operates in unison with the transfer slides, and raises each blank, in turn, into line with the grippers of the loading slide. The latter then conveys it towards the first set of press-tools. When the stack of blanks is exhausted, the table is indexed automatically, to present a fresh stack to the lifting head, without interruption of the transfer sequence. The empty magazines are removed and full magazines loaded, at the two idle positions seen in the foreground. Each magazine holds 150 10-s.w.g. blanks, and the full magazines are usually loaded into the holders in pairs, at 24-min. intervals. Access is gained through metal gates, and unless these gates are closed, the table will not index.

The machines are standard wheel presses, with a stroke of 14 in. and a bed cushion capacity of 50 tons. Each is equipped with the special ejector system shown in Fig. 5, comprising a pivoted cam *F* at each side of the main slide, and an associated link *G*, connected to a stationary portion of the machine. An ejector bar *H*, mounted transversely in the main slide, is held in

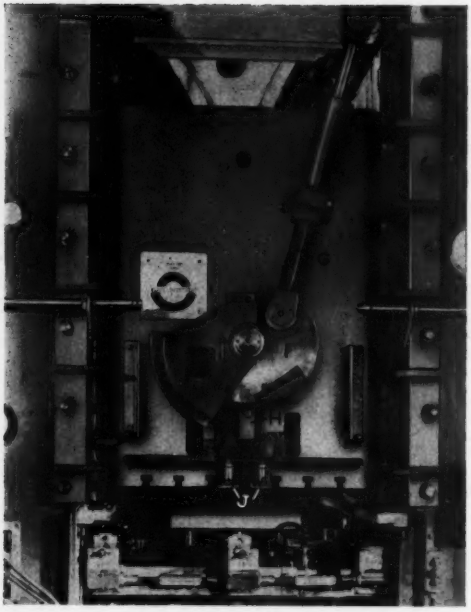


Fig. 5. This view shows details of the special ejector system with which the presses are equipped. The cam *F* is connected to the frame by the link *G*

contact with the cams by the small air cylinders *J*, and the cams are turned, through the action of the links *G*, by the movements of the main slide. The cam profiles are such that the ejector bar momentarily remains stationary during the upstroke, so that the work is stripped from the punch assembly. The pressing thus remains in the bottom tool, whence it is ejected, and raised to the required height for engagement by the transfer grippers, by air-operated pins. A typical set of tools, with the bottom ejector pins raised, is shown in Fig. 6, in which two of the grippers may be observed at *K*.

Although the presses and transfer equipment are electrically interlocked, to operate in unison, the press clutches are engaged and disengaged independently, so that any press can be stopped at will, whether or not the transfer system is in operation. Throughout, automatic safeguards against mis-feeding, double feeding, and incorrect location of the work in the dies, are provided, which stop the entire line should any of these faults occur. Equipment for this purpose includes a "gauging" gripper on the loading slide, which detects the accidental feeding of more than one blank due to adhesion, and switches that "check" each pressing into and out of each die. Misplaced blanks or pressings, between tool stations, are detected by photo-cell units, one of which is seen at *L* in Fig. 3, and similar units are incorporated in the tools, as at *M* in Fig. 6, to check for correct location.

If the work is not properly positioned in any particular die, the press in question is immediately stopped, even if it is in the mid-stroke position. In such an event, the remainder of the line completes the cycle, and stops in readiness for the

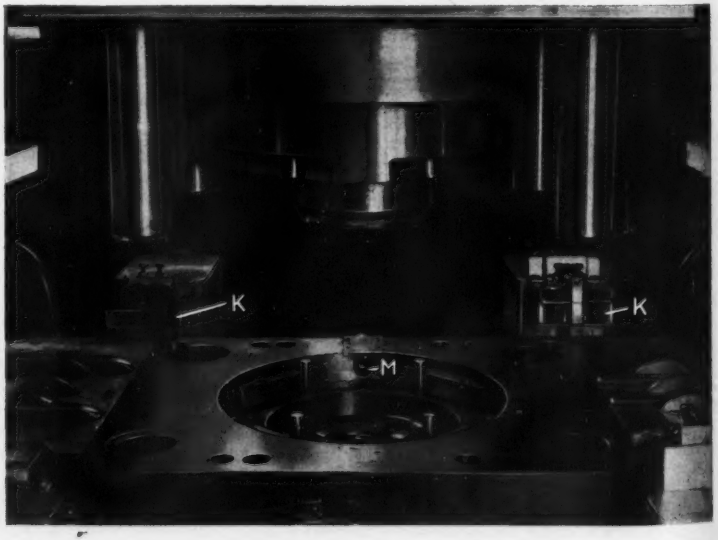


Fig. 6. In this view of a typical tool station, the bottom ejector pins are seen raised. Correct location of the work in the die is "checked" by the photo-cell *M*

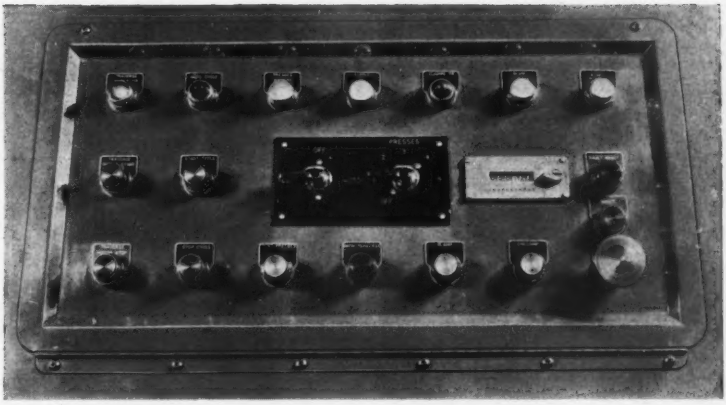


Fig. 7. Close-up view of the centralized panel, showing the grouping of the controls, and the row of coloured signal-lamps

next. Should it then be required to operate the press manually, to complete the operation that has caused the shut-down, this function can be selected by means of the appropriate controls for "single cycle" and "re-set." If any press in the line is out of phase with the remainder, by more than a certain predetermined amount—for example, because of a momentary arrest—all the presses are stopped at the end of the cycle. A cycle "stop" button provides for stopping the line on completion of a cycle, in the correct position for restarting, whereas operation of any of several "emergency stop" buttons shuts down the line immediately. It is then necessary to inch the presses and transfer mechanism to the "start" position, by means of controls provided for this purpose.

All controls, including those for manual operation, are conveniently grouped on a centralized panel, as shown in Fig. 7. The panel is also provided with a series of coloured signal lamps which are illuminated to indicate, for example, "traverse motor on", "presses running", "auto cycle". Faulty functioning detected by the safety devices already mentioned is signalled by a "blank displaced" lamp. In the centre of the panel, there are two selector switches, each of which can be locked by means of a Yale-type key, to prevent unauthorized interference. The switch at the right provides for the selection of any one of the five presses in the line, and that at the left for "test", "auto" or "off", for the particular press selected. At the "test" setting, the various functions can be checked individually.

The line is normally tended by two operators, one of whom is stationed at the control panel, the other being responsible for inspecting the finished pressings as they are delivered. Automatic lines of this design, it is pointed out, can readily be arranged to incorporate any desired number of presses, and change-over of tooling on the line here described, for individual manual operation, can be effected in approximately one hour. The system is thus sufficiently versatile to satisfy widely differing production demands.

A colour cine film of the line in operation has been produced on behalf of Wilkins & Mitchell, Ltd., by Saga Films, Ltd., which clearly shows the various phases of the press and transfer cycles. It also demonstrates the effectiveness of the automatic safeguard devices. Copies of the film, which runs for approximately 7 min., are in course of preparation, and will be available on loan, on application to Wilkins & Mitchell, Ltd.

Books Received

SOME ASPECTS OF QUALITY CONTROL IN BRITAIN, AMERICA, GERMANY AND RUSSIA. By A. R. Byford. The Institute of Industrial Supervisors, 24 Albert Street, Birmingham 4. 48 pp. [Price 3s.]

The many benefits to be derived from quality control are described in this booklet, and some examples are given of applications in this country and America. Reference is also made to the later adoption of quality control techniques in Germany and Russia, and to the organizations interested in their development. The various sources of the information given in the booklet are listed, together with some recommended books on the subject of quality control.

FIRE FIGHTING IN INDUSTRY. Ministry of Labour Safety, Health and Welfare Series No. 10. H.M. Stationery Office. [Price 2s. net.]

This 43-page booklet provides a guide to the requirements of Section 12(1), Factories Act, 1959, and, following an introduction, gives useful information on the nature and types of fire risk, fire fighting agents, and kinds of equipment. Other sections are concerned with the correlation of fire fighting agents and types of fire risk, and with recommended standards for fire-fighting equipment. The installation and maintenance of equipment is also considered, and notes are included on training in the use of portable appliances, and on fire detection systems.

NEWS OF THE INDUSTRY

The North West

CRAVEN BROTHERS (MANCHESTER), LTD., Vauxhall Works, Reddish, Stockport, inform us that there has been a continued improvement in the volume of orders received during recent months, which have covered, for example, sliding, surfacing and screwcutting lathes from 21 up to 72 in. centre height; a 56/83-in. centre, break lathe; a 40-in. centre, roll turning lathe; a special armature banding lathe; three ingot planing machines; a 13-ft. by 10-ft. 6-in. by 30-ft. stroke planing machine; a portable radial planing machine; and a small open-side plano-milling machine. Orders are also in hand for railway machines, including an axle journal lathe and a pit type wheel lathe with electric profiling equipment and friction roller drive; vertical turning and boring mills from 10-ft. to 24-ft. diameter capacity; 60-in. and 70-in. heavy-duty roll grinding machines; a 40-in., extra heavy-duty, 3-wheel type roll grinding machine, with a 150-h.p. wheel drive, for the rapid removal of stock from as-cast rolls without previous turning. Among special machines and equipment may be mentioned a 15-ft. by 15-ft. self-contained rotary table suitable for use on a large horizontal boring machine; a billet drilling machine; a 24-in. wobbler end milling machine; and one 18-in. centre and three 16-in. centre high speed tube boring machines.

Our attention was drawn to an interesting rotary turning machine which has recently been ordered for operations on the shaft ends and inner curved edges of water turbine runner blades, including cylindrical turning, coning and screwcutting on the blade shanks, and radius turning and milling operations on the blade edges.

During our visit to the works, we noted two axle journal roughing and copy turning lathes on test, also an axle ending and centring machine, all of which are destined for India. Machines seen in progress included 40- and 60-in. roll grinding machines; four friction roller drive wheel lathes arranged for electrical profiling; a 14-ft. capacity vertical turning and boring mill; a loco-frame plate milling machine; a 5-ft. rotary crank pin turning machine; a number of railway machines; and roll turning lathes of various sizes, one of which of 17-in. centre height, will be equipped for electrical profiling.

We are informed that a 65-in. roll grinding machine with a geared type work-head, and a 26-in. roll grinding machine with V-belt drive to the head, have recently been completed, and that a number of railway axle waist roughing lathes, with duplex hydraulic copying equipment, have been shipped to India.

THOMAS ASHWORTH & CO., LTD., Sycamore Avenue Rose Grove, near Burnley, are busy with the production of gravity and pressure die castings, moisture testing instruments, and textile equipment. We are informed that there is a steadily increasing demand for die castings which are being produced for a wide variety of users, including makers of medical equipment and the domestic appliance, agricultural machinery, motor vehicle and aircraft industries. It may be noted that an order for 100,000 die castings for export to U.S.A. was recently completed.

A Herbert Reed Prentice 1½ G die casting machine for aluminium has recently been added to the plant.

JAMES PROCTOR, LTD., Hammerton Street, Burnley, long-established as makers of mechanical stokers, and coal and ash handling plant, inform us that a steady flow of orders is being received for their range of products and that there has been a marked increase in the number of enquiries received in the past few weeks. When the Clean Air Act came into force, the company started production of the Proctor unit wide ram coking stoker which has been designed to comply with all the requirements. In addition to the usual machining and assembly departments, the facilities include a foundry, in which castings are produced for use in the firm's products, also for a number of other manufacturing companies in the district.

ROBERT SCAIFE (COLNE), LTD., Swanfield Works, Clarence Street, Colne, makers of milling machine arbors and adaptors, inform us that in addition to their standard range of equipment, for which there is a good demand both from users and machine tool builders, they produce special arbors and adaptors to suit the requirements of customers. Other activities include the production of jigs,

boring bars, special small tools, and fixtures to customers' designs, the building of woodworking machinery under contract, and precision machining of components on a contract basis for various firms in the area.

SCAIFECO, LTD., 70A Keighley Road, Colne, are steadily occupied with the production of their range of equipment, which includes 4-speed gearbox units; 6-in. belt grinding machines of both pedestal and the bench types; and bench and pedestal grinding machines provided with two 9-in. diameter wheels. Special tooling and equipment is also made, including machine adaptors and arbors, to meet customers' needs.

ASQUITH ELECTRICS (COLNE), LTD., Walton Street, Colne, a member company of the Asquith Machine Tool Corporation, Ltd., inform us that they have an expansion scheme in hand which will ultimately increase their manufacturing capacity by about 200 per cent. Additional plant is now being installed in the factory extension to augment the production of steel cabinets, electrical component parts, and specialized textile electrical equipment.

The company is concerned mainly with the production of electrical control panels which are supplied to associate firms, also to machine tool builders, lift and hoist manufacturers, and other engineering organizations outside the Asquith Group. In addition to utilizing component parts made in the works for control panels, the company produces panels incorporating Brookhirst Igranic, M.T.E., Square D, and other makes of components to suit customers' requirements.

Other services which the company has provided for the past 15 years will also be extended. These services include the production of special switchgear for the Coal Board and other organizations, the manufacture of transformers up to a capacity of 20 kVA., and the production of electrical equipment for the automatic control of textile machinery, yarn breakage detectors, and other specialized textile items.

RIGG BROTHERS (TOOL MAKERS), Colne, are well occupied with the production of press tools, jigs, fixtures, and special tooling, for a variety of users, including machine tool builders. The construction of prototype and special machines and equipment is also undertaken.

ARTHUR DIDGSON (ARDON), LTD., Whitefield Mill, Nelson, inform us that they are maintaining a steady output of their range of textile equipment of patented designs. In addition, this company undertakes a certain amount of contract machining work, and offers heat treatment and protective treatment services to the industry, for which there is a steady demand from aircraft, motor vehicle and machine tool firms.

EDDLESTONE & CO., LTD., Padiham, are busy with the production of components in Nimonic and stainless steels, on a contract basis, for the aircraft and other industries. The turning capacity of the works has recently been augmented by the addition of a Lang 24-in. by 108-in. type B, a Lang 20-in. by 42-in. type B, and two Lang 42-in. by 108-in. capacity centre lathes.

In addition to carrying out contract machining, this company operates an iron foundry which has capacity for producing castings up to 4 cwt.

DORMAN & SMITH, LTD., Atherton Works, Blackpool Road, Preston, makers of Cubicon electric switch boards and control units, and various types of air-break switchgear up to 750 amp. capacity, inform us that there is a steady demand for all their products from customers in both the home and export markets.

UNIT TOOL & ENGINEERING CO., LTD., Sutherland Road West, North Shore, Blackpool, inform us that their works are busy. Activities of the company include the design and construction of special plant and equipment, for some of the larger firms in the United Kingdom, precision engineering for shipyards engaged on Admiralty work, and the production of components and units. The wide variety of products marketed includes paperless labelling machines for the use of consumer goods manufacturers, and automatic photographic processing equipment. The position as regards contracts for Admiralty work, especially for instrumentation, is reported to be satisfactory.

The subsidiary company George Cheswick, Ltd., Mowbray Drive, Layton, Blackpool, has a good order book for high grade ferrous and non-ferrous castings for use in the atomic energy field and for special purpose machine tools. This company also designs and produces oxygen-gas cutting machines, and cutting, welding and heating nozzles.

GAUGES-BOURDON (GREAT BRITAIN), LTD., Sutherland Road West, Blackpool, an associate company of Unit Tool & Engineering Co., Ltd., are extremely busy with the production of precision pressure gauges, vacuum gauges, liquid level gauges and recorders, in association with Bourdon, Paris, the originators of Bourdon tubes.

J. FISHER & CO. (CLEVELEYS), LTD., Cleveleys, report that they are fully occupied on plastics moulds, jigs, fixtures, press tools and special tools for use in a wide range of industries. In addition prototype components in plastics are made for the electrical industry. An extension to the works has recently been completed which has increased the

floor area by 100 per cent., and it was noted that new equipment recently installed includes a G.K.N. spark erosion machine; a Cincinnati Contourmaster die-sinking machine equipped with hydraulic tracing equipment; and a bench type jig boring machine built by Bloctube Controls, Ltd., Aylesbury. Delivery of a Burdett surface grinder, with a table capacity of 18 in. by 6 in., is expected shortly.

R. SUTCLIFFE.

The South

VERO PRECISION ENGINEERING, LTD., South Mill Road, Regents Park, Southampton, are still busy with orders for precision parts, press tools, large fixtures, and forging dies for steam turbine blades. Vero type 3125 and 5625 Autodrills, with tape control, are being built for a number of British firms and it is anticipated that versions of this type of machine will later be offered for export. Machine tools recently acquired have included a Société Genevoise Hydroptic 6A jig boring machine provided with D.I.R. automatic repeating equipment as shown at the International Machine Tool Exhibition at Olympia last year.

SOUTHERN ENGINEERING & MACHINERY CO., Connaught Buildings, Tanners Brook, Millbrook, Southampton, are experiencing a good demand for a wide range of machine tools and the shops are still very busy with machine tool rebuilding and general machining to the trade. This company, it may be recalled, is the British agent for Ets. P. Huré, Paris, and machines recently sold have included a type 86 A universal milling machine.

HELI-STRAND TOOLS, LTD., Rye, Sussex, are now well established in their new works which have been built on a 1½-acre site adjoining Winchelsea Road. The premises are to be extended in accordance with an expansion programme which provides for the erection of office buildings and additional production bays. These bays will be devoted to the manufacture of flexible shafts and flexible shaft equipment, for which there is a rapidly increasing demand. Special purpose machinery is installed for the production of flexible shafts with diameters from 2¼ mm. upwards, the larger sizes being suitable for driving workshop equipment and agricultural appliances. Output of portable, electrically-driven, single- or multi-speed flexible shaft drive units for factory use is increasing. The heads fitted are of patented design and embody a quick-change coupling to facilitate the interchange of tools.

ROTHER IRONWORKS, LTD., Rye, Sussex, who produce Nerus flexible shaft drive equipment and a wide variety of grey iron castings, are still busy in both fields. Contract work is also in progress, involving the supply of partly- or fully-machined castings for machine tools and other engineering equipment.

F. W. HERRIDGE.

Navy Apprentices Training Centre

Coinciding with the start of Commonwealth Technical Training Week, the Admiralty have opened a new apprentices training centre at H.M. Dockyard, Chatham. Situated in the former Collingwood block of the Royal Naval Barracks, the centre provides facilities of a high standard for training all fitter apprentices in the Chatham Dockyard. Modern laboratory, classroom, and workshop equipment has been installed, and an im-

A view of part of the machine shop at the new apprentices training centre at Chatham Dockyard

pression of the layout of the machine shop is given in the accompanying illustration which shows part of the lathe bay. In all, some 80 machine tools are installed.

At present, about 1,100 apprentices, who are preparing for a wide variety of trades, are being taught by 40 instructors. Entry to the centre is by way of an Admiralty examination, and aptitude tests. Entrants under the crafts scheme spend the first two years of their training under instructors, and for the third and fourth years, they are engaged on productive work under craftsmen. In the fifth year, they work alone, and at the end of this period they take a trade test to become qualified craftsmen.

During the 5-year period, apprentices can take courses up to the final of the London City and Guilds Institute or courses for the Ordinary and Higher National Certificates.

Yale & Towne Demonstration

The wide range of materials handling equipment made by The Yale & Towne Manufacturing Co., British Materials Handling Division, Willenhall, Staffs., which was demonstrated recently, includes the K.51 electric fork-lift truck, of 4,000 lb. capacity, shown in the accompanying illustration. The twin-fork attachment may be rotated continuously or tilted to any angle in either direction, and may be employed, for example, for discharging foundry sand from containers. It will be noted that the filled container is held securely during transportation and manipulation by the projecting forks of the rotating device. The operator has a clear view of the stationary container and is able to direct the discharge of the load without leaving the driving seat.

Yale & Towne K.51 battery fork-lift truck fitted with a rotating fork attachment

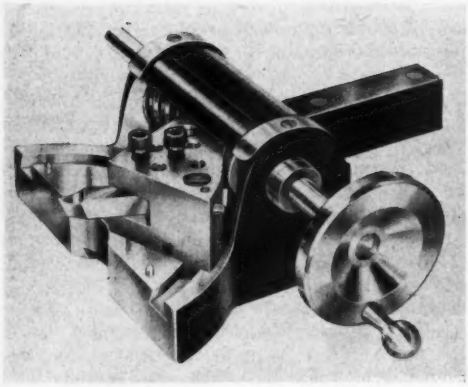
Controls are conveniently grouped for easy manipulation close to the steering wheel of the truck and are designed for sensitivity in operation. A safety feature is an arrangement whereby the brakes are applied, and power is cut off from the battery, in the event of the driver leaving the seat of the vehicle. It may also be noted that a valve is incorporated in the hydraulic circuit to prevent sudden uncontrolled lowering of the load in the event of pressure failure for any reason. The front wheels are driven through a fully-enclosed double reduction spur and hypoid gear transmission, and power is supplied by a 36-volt battery which permits a road speed, under full load, of 4½-5 m.p.h. A piston-type Yale lifting cylinder, supplied by a low pressure hydraulic pump, is employed for raising the fork assembly and the column is tilted forwards and backwards by two double-acting cylinders.

Yale & Towne also build pedestrian-controlled battery-driven trucks, with or without fork lifting equipment, and hand-operated lifting platform trucks for warehouse and workshop use. Early in 1960, the company introduced the first British-built Yale tractor shovel for earth moving and similar applications. Known as the Trojan type 154 LD this shovel has been exported to more than 20 foreign countries, and such deliveries have accounted for 80 per cent of the total so far built. A new version, known as the 204 2-yard Trojan, is now in production and is equipped with a Leyland UE 350 oil engine, Allison Torqmatic transmission, and planetary drive to the wheel axles.

The Habit Turn-a-Round Attachment

Introduced recently by Habit Diamond Tooling, Ltd., Lurgan Avenue, London, W.6, the Turn-a-Round spherical and radius turning attachment shown in the figure is intended for use on lathes and shaping machines. It has a rigid cast steel body with an $\frac{11}{16}$- by 1- by 4-in. shank which is normally clamped directly in the tool-post. With the aid of a setting chart which is supplied, the attachment can be rapidly adjusted to produce convex radii up to ¾ and concave radii up to 2½ in. A full 90-deg. radius form can be produced at one setting, and if twin tool bits are employed it is possible to machine an arc of 180 deg.

The attachment can be operated close to a faceplate or chuck, and there are no restrictions on the diameter or length of workpiece on which radii can



Habit Turn-a-Round spherical and radius turning attachment

be turned. It is stated, moreover, that for many set-ups, the attachment can be left in position on a 4-way tool-post without interfering with normal turning operations.

As will be observed from the illustration, the tool-holder block is guided in a semi-circular dovetail groove, in which it is traversed by a worm of special form. For convenience in operation, the handle can be mounted at either end of the worm shaft.

The attachment, which has a weight of approximately 7 lb., measures 7 in. wide, and the depth of the body portion is 3½ in. The height of the tool from the lower surface of the shank is ¾ in.

Trade Publications

BILLETOP & GILPIN, LTD., Victoria Road, Albert Street, Syston, nr. Leicester.—Cards for use with the company's brochure on Holfos bronze standard bearing bushes giving prices, also dimensions and tolerances for these bushes.

C. M. G. CALVER, LTD., High Street, Bushey, Herts. —Leaflet describing the Revlac No. 810 universal "trigrinding" machine for external, internal and surface grinding. A new price list of the company's standard products has also been issued.

HAGAN CONTROLS, LTD., 14 Grosvenor Place, London, S.W.1. Brochure in which the full range of ring balance meters produced by the company for measuring and recording fuel flow is described and illustrated.

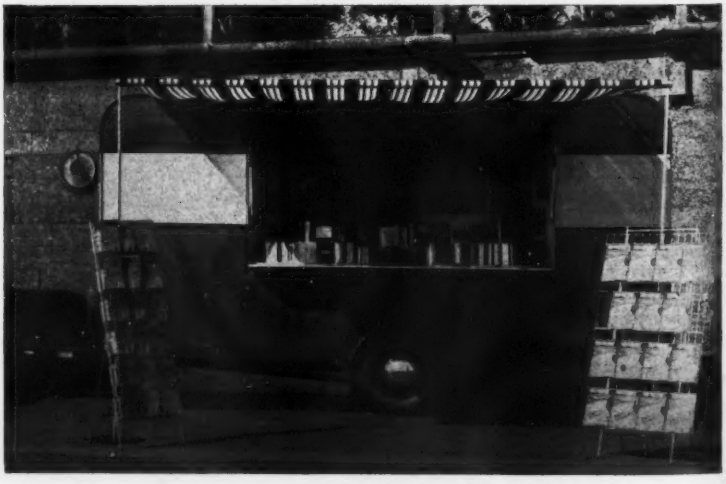
PETERBOROUGH DIECASTING CO., LTD., Padholme Road, Peterborough. Fully illustrated brochure showing examples from the wide range of zinc and aluminium die castings made by the company for various customers. Attention is also drawn to the products in which these castings are employed.

NEW PROCESS WELDERS, LTD., Nelson Place, City Road, London, N.1. Folder with illustrations and brief descriptions of the company's range of products which includes various types of spot welders, also gun, projection, seam, butt, and flash butt welders, and resistance heaters for rivets and other workpieces.

CROMPTON PARKINSON, LTD., Crompton House, Aldwych, London, W.C.2. Fully illustrated catalogue, with price list, covering the full range of commercial and display lighting equipment available for use with fluorescent and tungsten filament lamps. Attention is drawn to the service provided by the company's lighting engineers, to ensure that the equipment is used most effectively and economically.

MACHINERY'S Mobile Exhibition

To make current copies of MACHINERY readily available, to afford a convenient opportunity for examining a range of technical books on a wide variety of subjects, and to provide information on the other services that we offer, the mobile exhibition van here illustrated will visit metal working factories in all parts of the country. Companies wishing to be included in tours that will be made in the principal industrial areas are requested to write to the Publishing Manager, Machinery Publishing Co., Ltd., National House, 21 West Street, Brighton, 1.



MACHINERY'S mobile exhibition van

Personal

MR. F. ALLAN EYRE, M.B.E., is now chairman and joint managing director, and LT.-COL. J. H. M. STENNETT, joint managing director, of Allan Eyre & Co., Ltd., Chatsworth Road, Chesterfield.

The following new appointments have been announced:

MR. N. O. Dicey as managing director and MR. K. J. MACKAY as director of Target Engineering, Ltd., Northfield Road, Coventry.

MR. A. CAMPBELL, B.Sc., and MR. E. R. SAYER, B.Sc., Ph.D., as representatives in Scotland and the Midlands, respectively, for Hilger & Watts, Ltd., 98 St. Pancras Way, Camden Road, London, N.W.1. Mr. Campbell will operate from the offices of Elesco Electronics, Ltd., 2 Fitzroy Place, Glasgow, C.3 (telephone, Glasgow Central 1082), and Mr. Sayer's address is 32 Mountford Crescent, Aldridge, Nr. Walsall, Staffs. (telephone, Aldridge 53151).

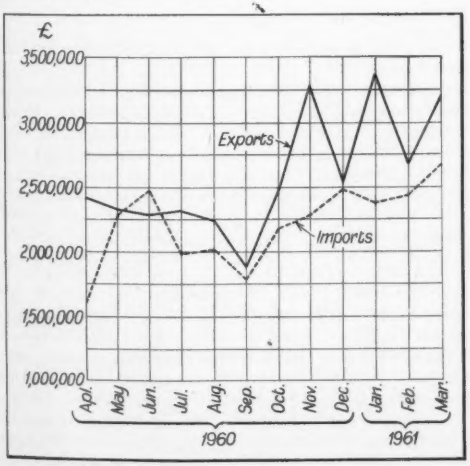
Obituary

MR. J. W. RYDE, F.Inst.P., F.R.S., chief scientist of the Hirst Research Centre of the General Electric Co., Wembley, Middlesex, died recently at the age of 63.

MR. FREDERICK BUCKLAND PERRY, a director of Robey & Co., Ltd., Globe Works, Lincoln, since 1921, died on May 22. He had been with the company for 53 years. A member of the Institution of Mechanical Engineers, Mr. Perry had served on the Regional Council. For some years he was a member of various technical committees of the British Standards Institution.

Machine Tool Imports and Exports

The accompanying graph shows the monthly fluctuations in imports and exports of machine tools in the year ended March, 1961.



MACHINERY'S ENQUIRY BUREAU

For many years MACHINERY has provided an enquiry service not only for subscribers and advertisers but for all engineers in need of such information as the names of makers—or their agents—of machines or equipment for performing particular operations, suppliers of various classes of material, firms with facilities for undertaking certain types of work, owners of trade names, and agents for foreign machine builders. If you have such a problem write (MACHINERY, Enquiry Bureau, Clifton House, 83-117 Euston Road, London, N.W.1) or telephone (Euston 8441, 2 lines). This service is, of course, entirely free.

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31/5/61

MANUSCRIPTS FOR BOOKS covering all branches of engineering production will receive careful consideration and should be sent to the Manager, Book Dept., MACHINERY, National House, 21 West Street, Brighton, 1.

CONDITIONS OF SALE AND SUPPLY.—MACHINERY is sold subject to the following conditions:

That it shall not, without the written consent of the publishers first given, be lent, resold, hired out or otherwise disposed of by way of trade except at the full retail price of 1s. 3d. and, that it shall not be lent, resold, hired out or otherwise disposed of in a mutilated condition or in an unauthorised cover by way of trade; or affixed to or as part of any publication or advertising literary or pictorial matter whatsoever.

Industrial Notes

THE ASTLEY INDUSTRIAL TRUST, LTD., Alport House, Quay Street, Manchester, 3, have opened an additional branch office at 31 Jameson Street, Hull (telephone, Hull 31212).

GEORGE H. ALEXANDER MACHINERY, LTD., 82-84 Coleshill Street, Birmingham, 4, have recently been appointed distributors, for the Birmingham and Wolverhampton area, for the range of machines for the production of metal boxes and drums made by Moon Brothers, Ltd., Birkenhead.

PRODUCTION OF CRUDE STEEL during the first quarter of this year averaged 5,870,000 tons per month in U.S.A., 2,899,000 tons in Western Germany, 2,070,000 in the United Kingdom, 1,962,000 (average for first two months) in Japan, and 1,534,000 in France.

GEORGE RICHARDS & CO., LTD., Broadheath, Altrincham, Cheshire, have secured an order to supply machine tools to the value of £750,000 to Heavy Electricals, Ltd., Bhopal, India, who are engaged in the heavy electrical manufacturing industry.

AN AUCTION SALE OF MACHINE TOOLS and miscellaneous stores will be held at Northern Command Ordnance Sub-Depot, Nr. Selby, Yorks., on June 21. The auctioneers will be Bartle & Son (Dept. L), 50-52 Merrion Street Leeds, 2.

GOODYEAR PUMPS, LTD., inform us that their Sales and Service Division has moved to new and larger offices at Walmgate Road, Perivale, Middlesex (telephone, Alperton 1132/3). A West End office will be retained at 44 Brook Street, W.1, London headquarters of the parent company, Holman Brothers, Ltd.

SIDNEY G. JONES, LTD., 8 Balham Hill, London, S.W.12. At a recent meeting of this company, resolutions were passed authorizing an increase in the nominal capital from £1,000 to £51,000 (51,000 ordinary £1 shares) and an increase in the issued capital from £428 to £51,000, as from January 27 last.

"THE TOOLS OF ENGINEERING RESEARCH" will be the subject of a course which will be held at Nottingham and District Technical College, Burton Street, Nottingham, from June 5 to 16. It is intended for full-time research workers and for lecturers concerned with research into mechanical engineering problems. Full particulars can be obtained from the above address.

CONFERENCE ON WORK STUDY.—The British Institute of Management, 80 Fetter Lane, London, E.C.4, will hold a one-day conference on Wednesday, June 14, at the Connaught Rooms, London, W.C.2, to draw the attention of directors and senior executives in industry to practical ways in which savings are being achieved by the intelligent application of work study.

MATCHLESS MACHINES, LTD. (Tesa Division), 18 Bolton Street, London, W.1, announce that Stuarts & Houston, 5 York Street, Glasgow, C.2, have been appointed area distributors for TESA measuring equipment for the whole of Scotland, and Batesons, Ltd., 105-111 Yorkshire Street, Rochdale, for Rochdale and surrounding area. Technical service and standard requirements of TESA instruments can be obtained from these companies.

INDUSTRIAL EDUCATION INTERNATIONAL, LTD., 66 Chandos Place, Strand, London, W.C.2, have arranged for 2-day workshop conferences on "Reducing Costs and Increasing Profits with Critical-Path Planning and Scheduling" to be held in London on June 26 and 27, and Birmingham on June 29 and 30. It is stated that the "critical-path" method represents a new approach to the problem of "better project control and co-ordination." Full particulars can be obtained from the above address.

SAFETY IN THE PRODUCTION AND CASTING OF NON-FERROUS METALS.—Requirements for the protection of workers engaged in the melting or founding of non-ferrous metals are proposed in a revised preliminary draft of the Non-ferrous Metals (Melting and Founding) Regulations, which have recently been issued. Copies may be obtained from the Ministry of Labour, Safety, Health and Welfare Department (W.5), 19 St. James's Square, London, S.W.1, and observations may be submitted up to August 31.

GLACIER METAL CO., LTD., Alperton, Wembley, Middlesex, draw attention to the advantages that can result from the adoption of standard bushes and bearings for new designs, particulars of which are given in their Designers Handbook No. 1. The range now available from stock includes 114 inch sizes and 137 metric sizes of wrapped bushes, 104 sizes of finish machined bronze bushes, and 65 inch sizes and 50 metric sizes of dry bearings.

FELDPAUSCH & CO. (ENGLAND), LTD., is the name of a new company that has been formed to handle the sales of equipment made by the German firm of Feldpausch. The range includes single and multiple screwdriving and nut-running machines, single and twin-spindle spin-riveting machines, and three sizes of vibratory feed units for these machines, which can also be adapted to machines of other makes. The address of the new company is 14 Valencia Road, Stanmore, Middlesex (telephone, Grimsdyke 2611).

KEARNEY & TRECKER-C.V.A. LTD., Garantools House, Portland Road, Hove, inform us that their sales Department is now handling all machine tools previously marketed by E. H. Jones (Machine Tools), Ltd., Hove, with the exception of Cincinnati press brakes and shears. It is emphasized that there has been no change in the Kearney & Trecker-C.V.A. manufacturing programme. Existing branch offices and showrooms will be retained in London (Edgware), Birmingham, Manchester, Glasgow, and Bristol. The Used Machine Division at Edgware will

continue to trade under the name of E. H. Jones (Machine Tools), Ltd.

THE NATIONAL LENDING LIBRARY FOR SCIENCE AND TECHNOLOGY.—It is announced that the buildings for the library are nearly complete and that literature has begun to flow on to the shelves. The reading room of the D.S.I.R. Lending Library Unit (which is being wound up) at 20 Chester Terrace, London, N.W.1, has been closed, and until June 30 would-be readers should enquire whether the literature they need is still at this address and whether it may be seen by arrangement (telephone, Hunter 8361, ext. 22 or 16). It is expected that the reading room at Boston Spa will be open at the beginning of September. The final issue of L.L.U. News (No. 6) gives particulars of arrangements during the change-over period.

Standard Length Bars

In the revised British Standard for length bars and accessories (B.S.1790:1961) which has recently been issued, a new calibration grade of bar is included, and particulars are given of a refined screwed connection, developed as a result of research work carried out by the National Physical Laboratory. With this connection, bars may be built into a combination without any appreciable loss of overall accuracy since, it is stated, changes in length which arise from the stresses that are set up during hand assembly are reduced to about 1 micro-inch per joint. The refined connection has also been applied to inspection bars.

Requirements for the accuracy of the four grades of length bars, namely, reference, calibration, inspection and workshop, have been modified to take account of the fact that modern end measuring machines are now provided with universally adjustable supports. In addition, requirements for accessories have been rationalized by the standardization of one type only.

Copies of the revised standard can be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1 (price 10s., postage extra to non-subscribers).

British President for E.C.C.M.T.I.

Mr. Robert W. Asquith, a past-president of the Machine Tool Trades Association and chairman of Asquith Machine Tool Corporation, Ltd., has been appointed president of the European Committee for Co-operation of the Machine Tool Industries. The first British president of the Committee, he will hold office for a 2-year term. The participating countries are Austria, Belgium, Denmark, France, Germany, Italy, Netherlands, Sweden, Switzerland, and the United Kingdom.

Correction

In the advertisement for Ajax Machine Tool Co., Ltd., Halifax, which appears on pp. 30 and 31 of this issue of MACHINERY, one of the entries in the list of stockists is incorrect. This entry should read J. Bates (Machine Tools), 9 Blakeney Court, Cookham Road, Maidenhead, Berks. Telephone Maidenhead 3169.

Scrap Metals

MIDLANDS.—Steelworks scrap is moving freely in this area with the exception of No. 5 bales for which markets are hard to find. The inclusion of non-ferrous materials in No. 5 bales has been causing steelworks considerable trouble, and merchants are likely to experience increased difficulties in disposing of this grade unless greater care is taken in eliminating materials which may spoil a melt. The demand for No. 4 bales is firm, preference being shown for the small size.

Disposal of turnings is becoming daily more difficult. The blast furnaces have reduced both prices and allocations and merchants are hard pressed to find outlets for tonnages arising from local factories.

The short heavy steel scrap users appear to be well stocked and will only accept deliveries against allocations. Surplus tonnages are available in the Midlands and merchants are building up stocks of all qualities. Fortunately markets for cast iron are strong and all grades can be delivered in this area. Prices for light quality cast material are easing slightly, but openings are available for all that is normally available.

Nickel bearing scrap, mainly from the drop forgers, can be loaded for prompt delivery, but mixed stamping flash is not wanted at special prices.

The call for destructor bales is mainly centred on those of the 12-in. cube type and prices for larger bales have eased by several shillings per ton.

In general, trading is more difficult, and merchants are finding it necessary to watch loadings to ensure that the scrap is strictly to specification if refusals are to be avoided.

Forming Metal by Magnetic Field

(*Continued from page* 1219)

magnetic fields for such operations as blanking, forming, embossing, and drawing. For this purpose a coil of flat spiral form is employed, and it is stated that the results obtainable with aluminium and aluminium alloys have been fairly well established. Investigations so far carried out have necessarily been confined to fairly small workpieces which can be made from blanks not exceeding 12 in. diameter by 0·125 in. thick. Obviously the capabilities of the process depend on the ability to store sufficient energy and to utilize that energy efficiently, and further research on storage and discharge arrangements and coil design will doubtless enable the field of application to be extended.

Already, however, it appears to have been established that the technique represents a potentially valuable addition to the available processes of high energy rate deformation, since it permits of "performing tasks at a quality level difficult to exceed by other means and sometimes impossible by other means."

Machine Tool Share Market

In stock markets trading was quieter during the period under review, and prices in most sections were inclined to ease with the slackening of demand, but the general undertone remained firm.

The gilt-edged market suffered from a lack of buying interest, and British Funds, together with other high-grade fixed interest stocks, finished with a slight setback in values.

Conditions were mixed in commercial and industrial share markets, with activity on a reduced scale. Steadiness gave place to easiness, and apart from a few good features, changes in balance were irregular with declines predominating.

Among machine tool issues, Edgar Allen lost 6d. at 45s. 9d.; Asquith Machine Tool, 3d. at 12s. 3d.; Birmingham Small Arms, 6d. at 34s.; British Oxygen, 1s. 6d. at 25s. 6d.; Brooke Tool, 1½d. at 10s. 3d.; Broom & Wade, 6d. at 27s. 9d.; Chas. Churchill, 3d. at 9s. 9d.; Coventry Gauge & Tool, 1½d. at 33s. 9d.; Craven Bros. (Manchester), 6d. at 11s. 3d.; Greenwood & Batley, 1s. at 27s.; Kerry's (Gt. Britain), 3d. at 11s. 6d.; Samuel Osborn, 6d. at 58s.; and John Shaw & Sons (Wolverhampton), 3d. at 20s. On the other hand, Abwood Machine Tool advanced 6d. to 2s. 6d.; John Harper, 4½d. to 8s. 9d.; A. A. Jones & Shipman, 9d. to 29s. 3d.; W. E. Norton (Holdings), 1s. 6d. to 9s. 6d.; F. Pratt, 1s. 1½d. to 19s. 10½d.; Sheffield Twist Drill, 1s. to 20s. 9d.; and Thos. W. Ward, 6d. to 83s. 6d.

JOHN HOLROYD & CO., LTD.—Interim dividend 5 per cent (same).

SHEFFIELD TWIST DRILL & STEEL CO., LTD.—Final dividend 16⅜ per cent, making, with the interim, a total distribution of 25 per cent for the year 1960.

New Companies Registered*

DESOUTTER PRODUCTS, LTD.—Registered May 11, 1961. To carry on the business of manufacturers of and dealers in pneumatic, hydraulic and electric tools and machinery, etc. Nom. cap.: £250,000. Directors to be appointed by subscribers. Subscribers: D. Brodigan and G. G. Ellston, 59/67 Gresham Street, London, E.C.2.

WOLVERHAMPTON GRINDING CO., LTD., 97 Dudley Road, Wolverhampton.—Registered May 8, 1961. To take over the business of precision grinding engineers carried on as "The Wolverhampton Grinding Company," at Wolverhampton, etc. Nom. cap.: £15,000. Directors: G. T. Case (permanent), R. Talbot, and A. J. Clarke.

* From the lists compiled by Jordan & Sons, Ltd., Company Registration Agents, 116-118 Chancery Lane, London, W.C.2.

COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd.	Ord.	1/-	2/6
Allen (Edgar) & Co., Ltd.	Ord.	£1	45/9
" " "	5% Prf.	£1	13/9*
Arnott & Harrison, Ltd.	Ord.	4/-	16/-
Asquith Machine Tool Corp., Ltd.	Ord.	5/-	12/3
" " "	6% Cum. Prf.	£1	16/6
Birmingham Small Arms Co., Ltd.	Ord.	10/-	34/-
" " "	5% Cum. "A" Prf.	£1	14/6
" " "	6% Cum. "B" Prf.	£1	17/-
" " "	4% 1st Mort. Deb.	Stk.	92
British Oxygen Co., Ltd.	Ord.	5/-	25/6 ex Capn.
" " "	6% Cum. Prf.	£1	20/6xd
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	10/3
Broom & Wade, Ltd.	Ord.	5/-	27/9
" " "	6% Cum. Prf.	£1	16/6
Brown (David) Corporation, Ltd.	5½% Cum. Prf.	£1	16/-
Buck & Hickman, Ltd.	6% Cum. Prf.	£1	17/-
Butler Machine Tool Co., Ltd.	Ord.	5/-	16/3
" " "	5% Cum. Prf.	£1	14/3
Churchill (Charles) & Co., Ltd.	Ord.	2/-	9/9
" " "	6% Cum. Prf.	£1	25/4½‡
Clarkson (Engrs.), Ltd.	Ord.	5/-	45/-
Cohen (George), 600 Group, Ltd.	Ord.	5/-	14/6
" " "	4½% Cum. Prf.	£1	12/6
Coventry Gauge & Tool Co., Ltd.	Ord.	10/-	33/9
" " "	5% Cum. Red. Prf.	£1	16/3
Craven Bros. (Manchester), Ltd.	Ord.	5/-	11/3
Elliott (B.) & Co., Ltd.	Ord.	1/-	3/7½
" "	4½% Red. Cum. Prf.	£1	12/-
Firth Brown Tools, Ltd.	4% Cum. Prf.	£1	11/-
Greenwood & Batley, Ltd.	Ord.	10/-	27/-
Harper (John) & Co., Ltd.	Ord.	5/-	8/9
" " "	4½% Red. Cum. Prf.	£1	11/9
Herbert (Alfred), Ltd.	Ord.	£1	78/6
Holroyd (John) & Co., Ltd.	"A" Ord.	5/-	22/6
" "	"B" Ord.	5/-	20/6
Jones (A. A.) & Shipman, Ltd.	Ord.	5/-	29/3 ex Capn.
" " "	7% Cum. Prf.	5/-	4/9
Kearney & Trecker-C.V.A., Ltd.	5½% Red. Cum. Prf.	£1	11/-
" " "	Prefd. Ord.	£1	13/9
Kearns (H. W.) & Co., Ltd.	Ord.	5/-	25/-
Kerry's (Gt. Britain), Ltd.	Ord.	5/-	11/6
Macreadys Metal Co., Ltd.	Ord.	5/-	17/3
Martin Bros. (Machinery), Ltd.	Ord.	2/-	2/6
Massey (B. & S.), Ltd.	Ord.	5/-	12/-
Newall Engineering Co., Ltd.	Ord.	2/-	11/9
Newman Industries, Ltd.	Ord.	2/-	6/3
" "	6% Prf. Ord.	5/-	5/-
Noble & Lund, Ltd.	Ord.	2/-	6/-
Norton, W. E. (Holdings), Ltd.	Ord.	2/-	9/6
Osborn (Samuel) & Co., Ltd.	Ord.	5/-	58/-
" " "	5½% Cum. Prf.	£1	23/-
Pratt (F.) & Co., Ltd.	Ord.	5/-	19/10½
Sanderson Kayser, Ltd.	Ord.	10/-	40/-
" "	6½% Cum. Prf.	£1	17/-
Scottish Machine Tool Corporation, Ltd.	Ord.	4/-	12/3
Shardlow (Ambrose) & Co., Ltd.	Ord.	£1	70/-
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	20/-
Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	20/9
" " " "	5% Cum. Prf.	£1	14/3
Stedall & Co., Ltd.	Ord.	5/-	8/10½xd
Sykes (W. E.), Ltd.	"B" non-voting Ord.	10/-	32/6
Tap & Die Corporation, Ltd.	Ord.	5/-	19/3
" " "	4½% Deb. 1961-1977	Stk.	82½
Wadkin, Ltd.	Ord.	10/-	26/-xd
Ward (Thos. W.), Ltd.	Ord.	£1	83/6
" "	5% Cum. 1st Pref.	£1	14/-
" "	5% Cum. 2nd Pref.	£1	22/6
Willson Lathes, Ltd.	Ord.	1/-	3/4½

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. ‡ Birmingham price.

Nº 5 FACING AND BORING MILLER

is of massive construction and designed for handling work beyond the scope of a conventional miller. Equipment includes vertical attachment, slotting attachment, separate boring head, outer stay, etc.

Table	64in. by 28in.
Power traverses	Longt. 52in. Cross 43½in.
Max. spindle to table	39in.
Spindle speeds (20)	16–1,000 r.p.m.
Feeds (12)	⅛in.–33½in.
Rapid traverses	79in. per min
Total H.p.	18
Weight	6·2 tons

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GRADE 'A'

Hand scraped and surfaced to within 0·0001in. to 0·0003in. from a mean true plane over whole surface according to size.

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Smooth planed finish accurate 0·001in to 0·003in. according to size.

Sizes up to 4ft. by 2ft. have three-point support.

Sizes 4ft. by 3ft. to 6ft. by 4ft. have five-point adjustable support.

Sizes 8ft. by 3ft. to 12ft. by 6ft. have six-point adjustable support.

Our Grade 'A' tables conform to B.S.S. 817-1938 in all respects.

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CROWN WORKS · CHELMSFORD · ENGLAND

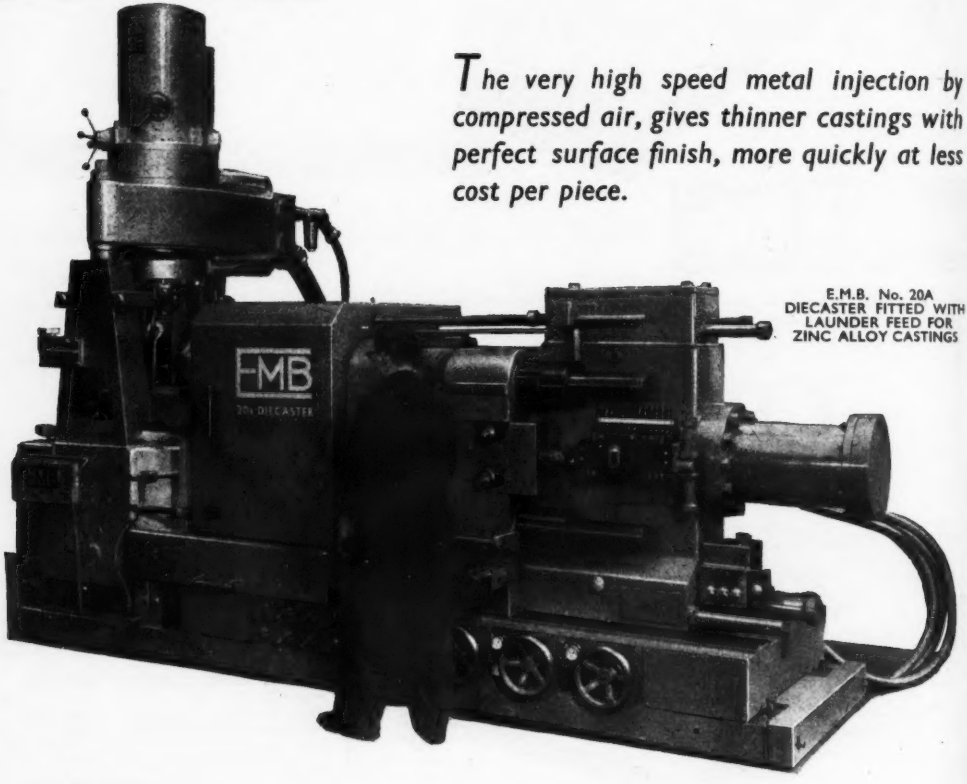
TELEPHONE CHELMSFORD 2224

It's quicker by air

Capacities:

Machine ...	6	10	12A	16	20A
Zinc lb. ...	¼	2¼	6·3	13·6	25·7
Alum lb. ...	—	1¼	2·1	4·5	—
Max. die ...	8½ × 9½	16 × 10	20 × 12½	28½ × 16½	35½ × 19¾
Platen stroke	4½	6	8	11	13

The very high speed metal injection by compressed air, gives thinner castings with perfect surface finish, more quickly at less cost per piece.



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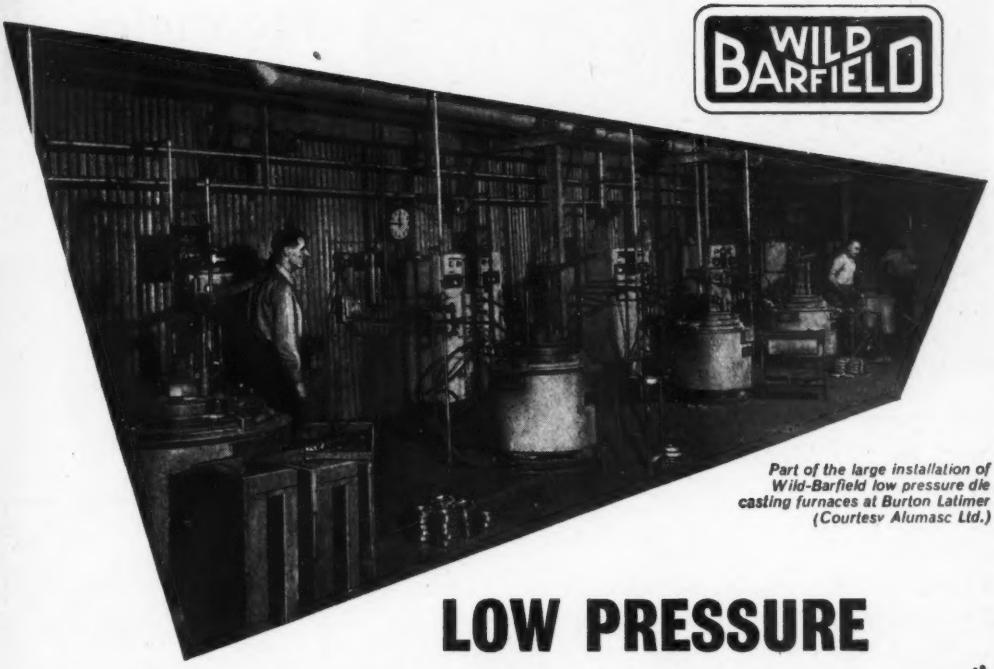

Part of the large installation of Wild-Barfield low pressure die casting furnaces at Burton Latimer (Courtesy Alumasc Ltd.)

LOW PRESSURE ALUMINIUM DIE CASTING FURNACES*

(Mains Frequency Induction Heated)

Simple to service

No elements to burn out

No channels to clean

No metal contamination

Accurate temperature control

Over 30 furnaces supplied to one well-known American Motor Manufacturer and currently used for production of Aluminium engine castings

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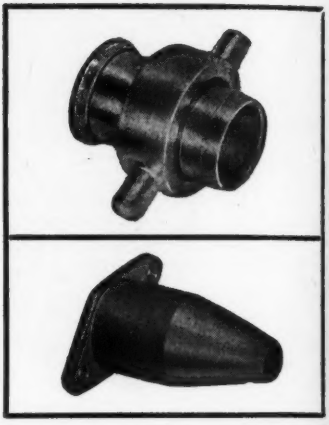

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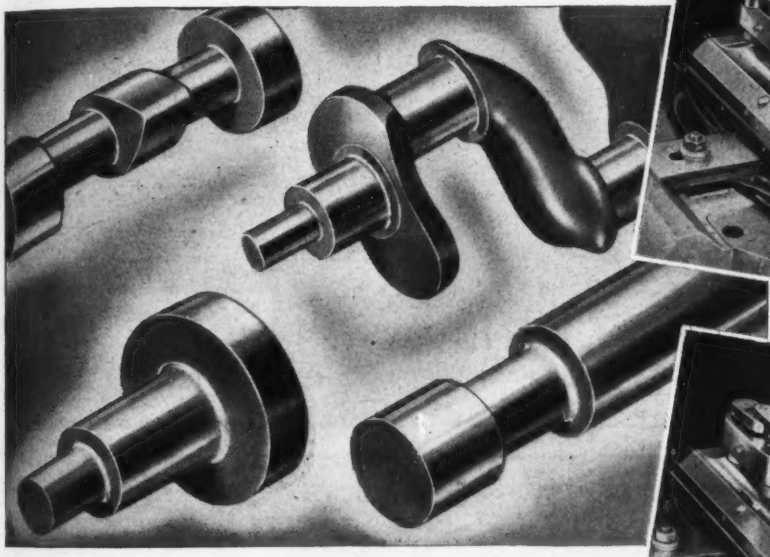
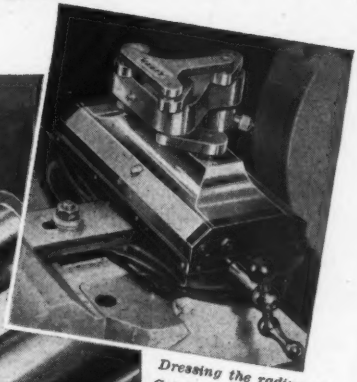
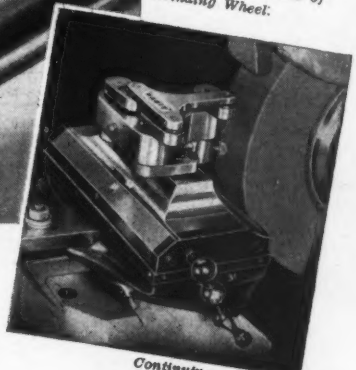




Dressing the radius of Grinding Wheel.



Continuing across the periphery of Grinding Wheel.

Ensure True Contour and Perfect Blend with the

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Wheels used for grinding components with single or double fillet radii must be dressed so that the point where the radius blends into the parallel portion of the shaft should be a true tangent, indispensible for Crankshafts, Stub axles, necked bolts, etc., etc. The Habit Tally-form provides a dressing fixture which, in **one pass** will dress the radius, continue across the wheel periphery and, if necessary, dress a second radius on the opposite side. Absolutely perfect dressing is thereby obtained.

NO LIMIT TO WHEEL DIAMETER

SMALL OVERALL DIMENSIONS

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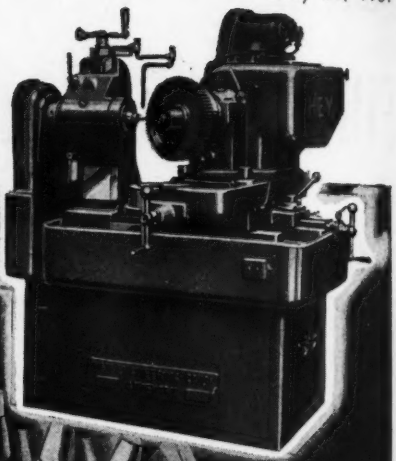
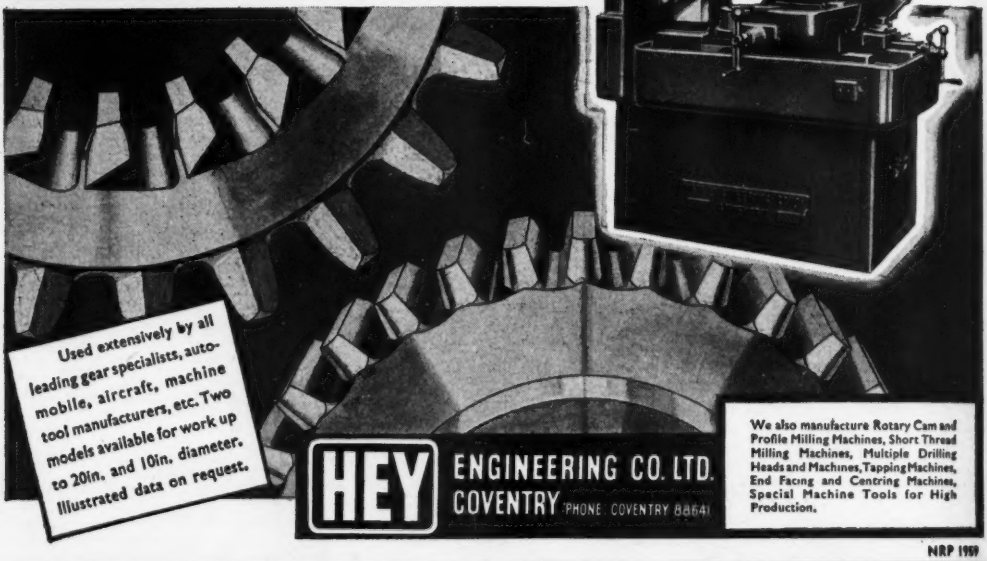
Automatic operation, High Production Rates on External and Internal Gears, Starter Rings, etc.





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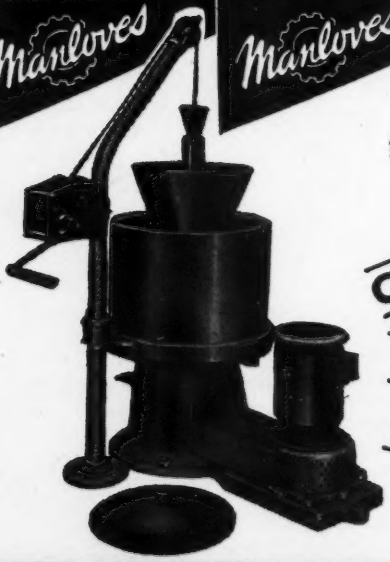

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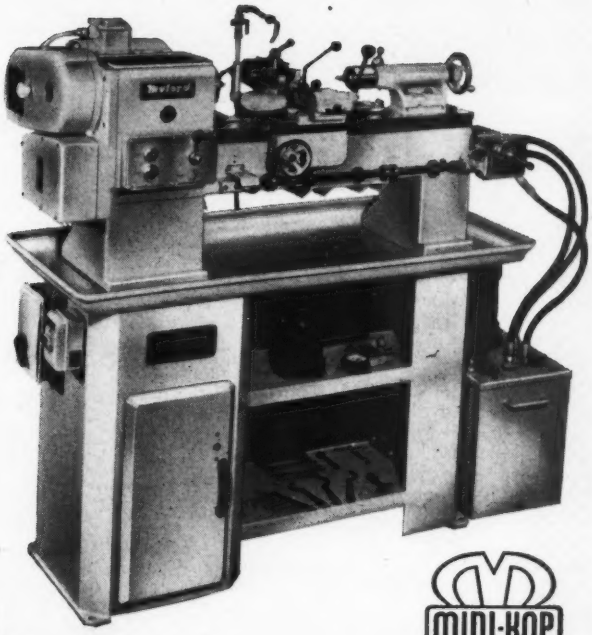
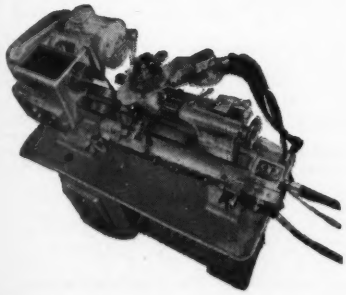
a high-speed hydraulic copying lathe for small parts



MINI-KOP

Myford MINI-KOP

SERIES 1A



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Will reproduce steps as small as 0.0005 inch.
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Will repeat diameters well within 0.001 inch.
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GISHOLT 1L & 2L Capstan Lathes.
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ALSO

B.S.A. 6 x 12 and 28 Multi-Tool Lathes.
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The above offered subject to prior sale. All machines motorised suitable for 400-440 volts, 3 phase, 50 cycle supply.

We offer good prices for your surplus plant. Send us details—we will inspect immediately and make a firm offer. Write, wire or phone . . .

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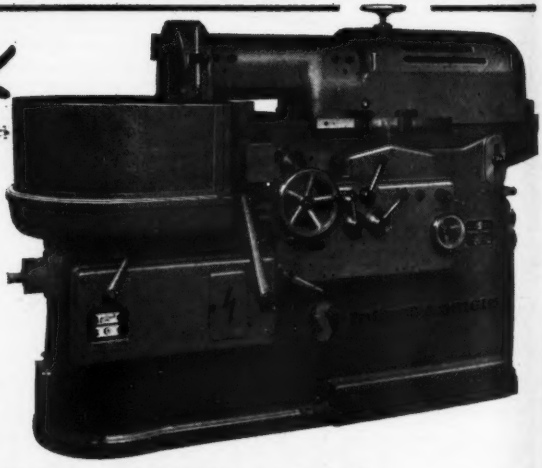

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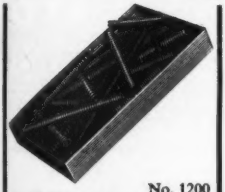

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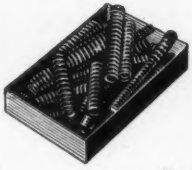

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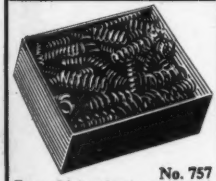

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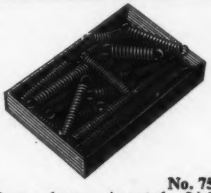

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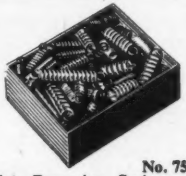

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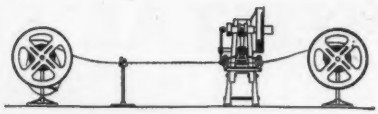

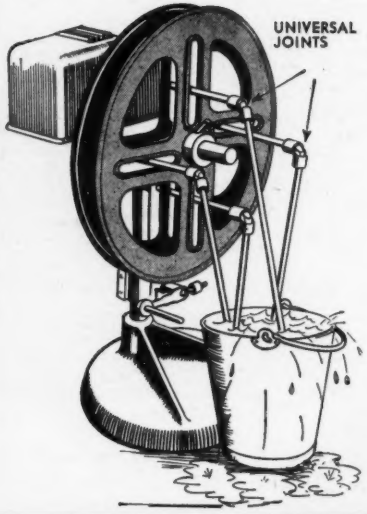

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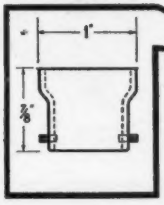

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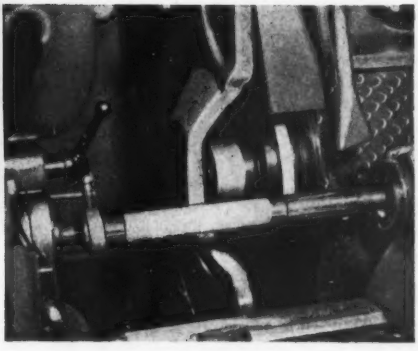

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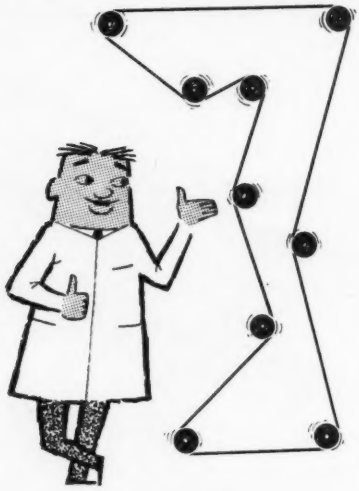

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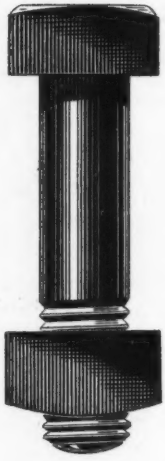

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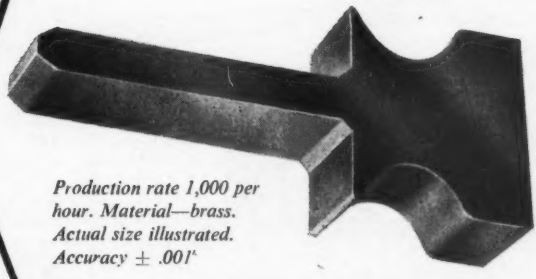

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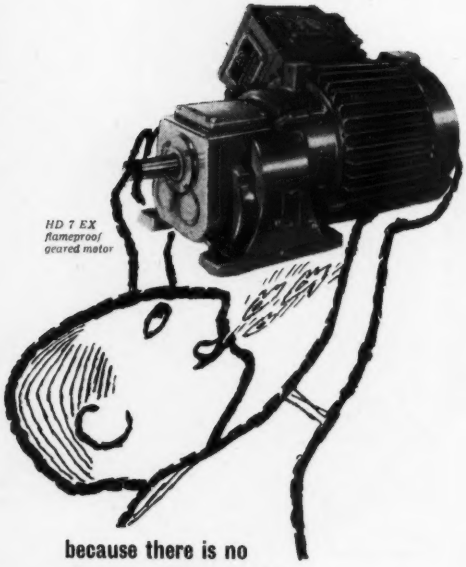

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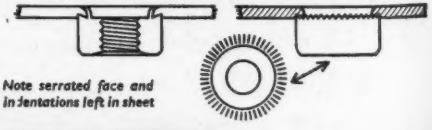

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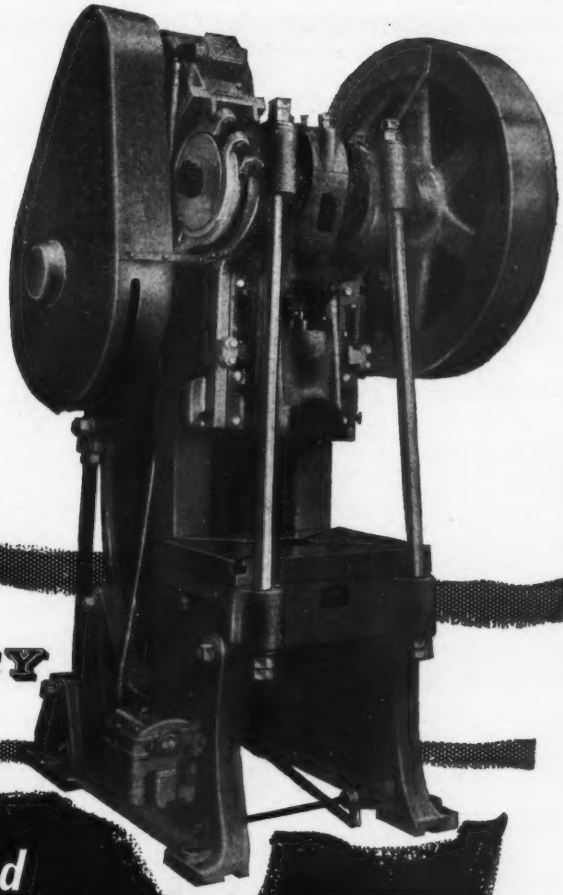

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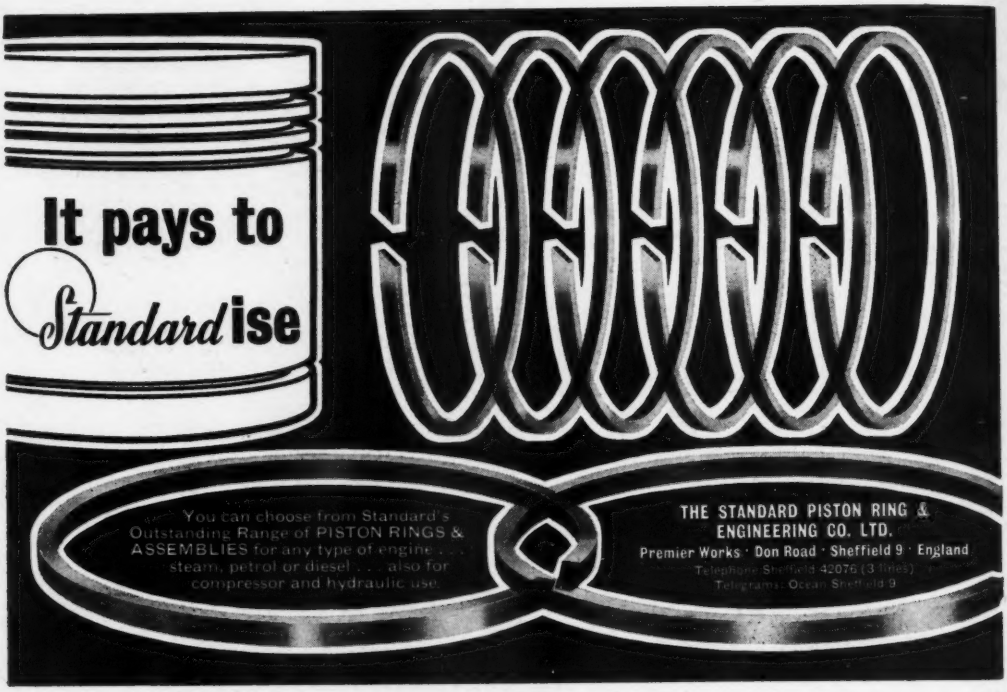
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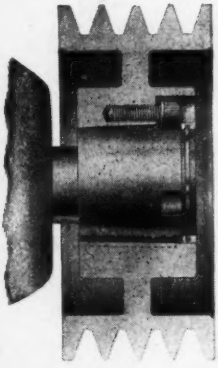

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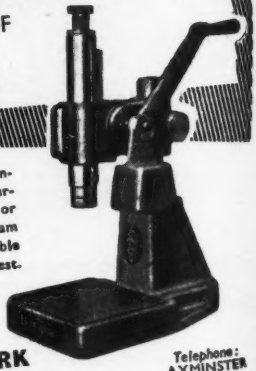

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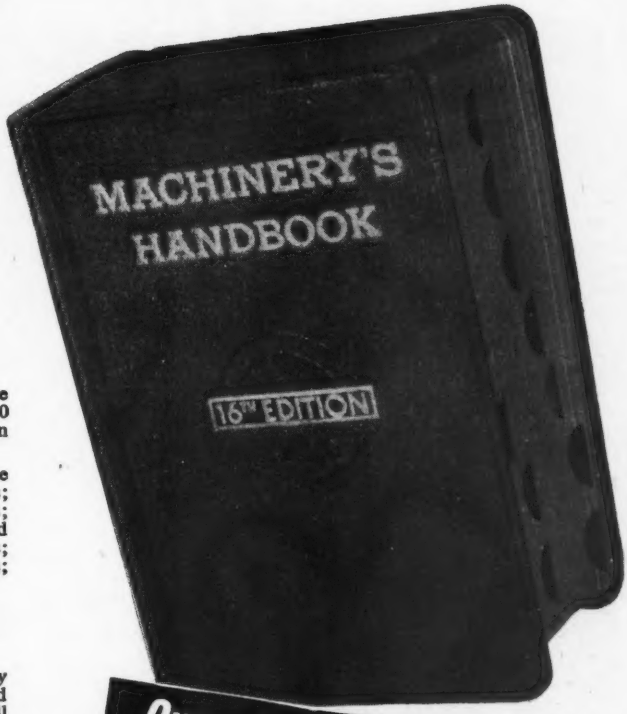

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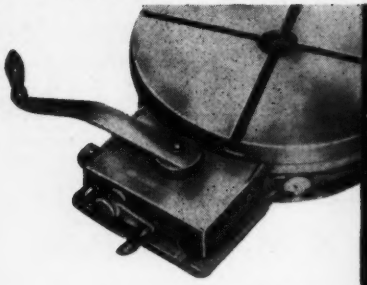

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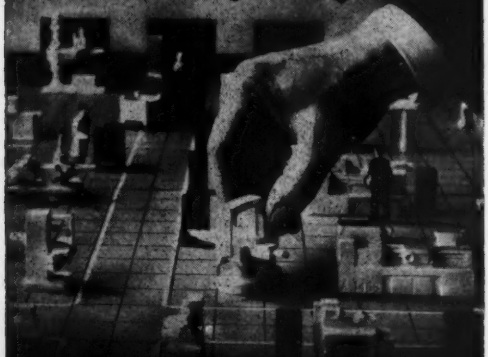

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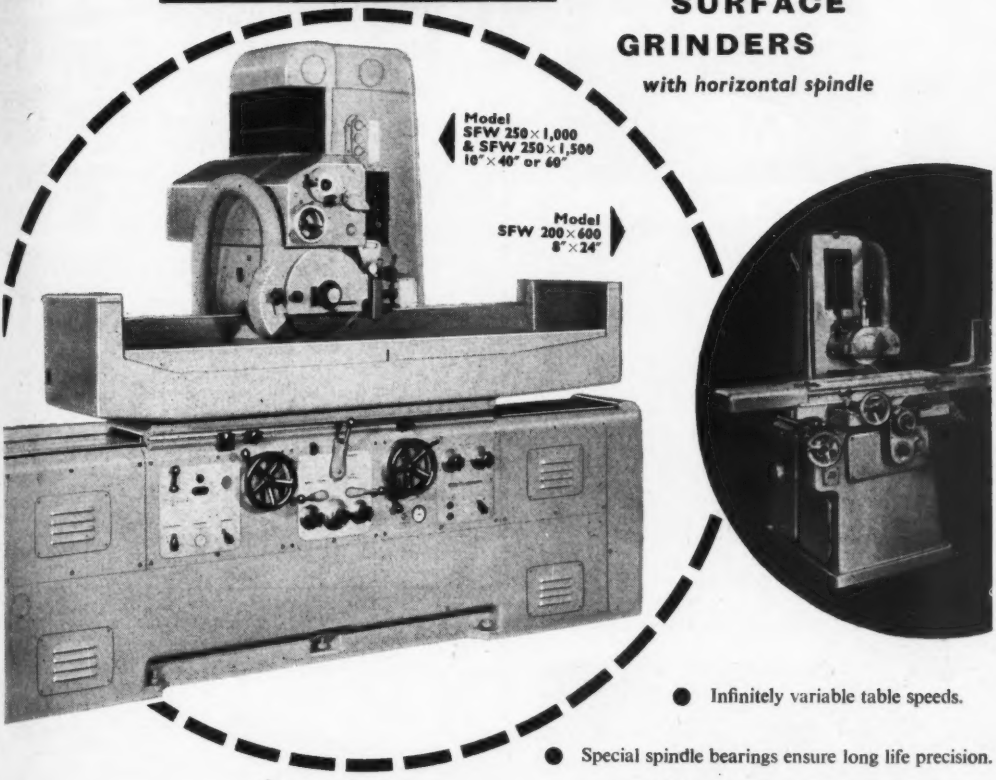

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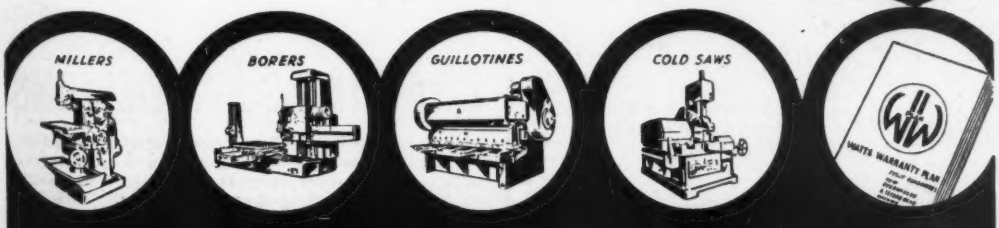

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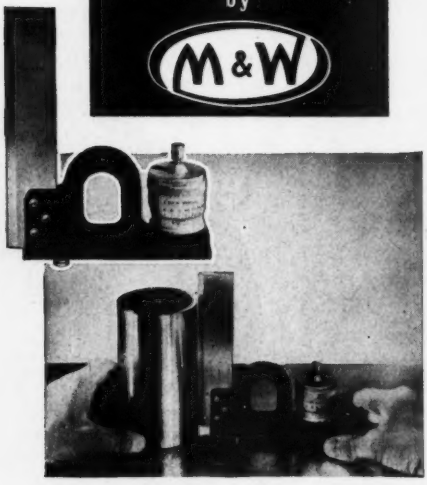

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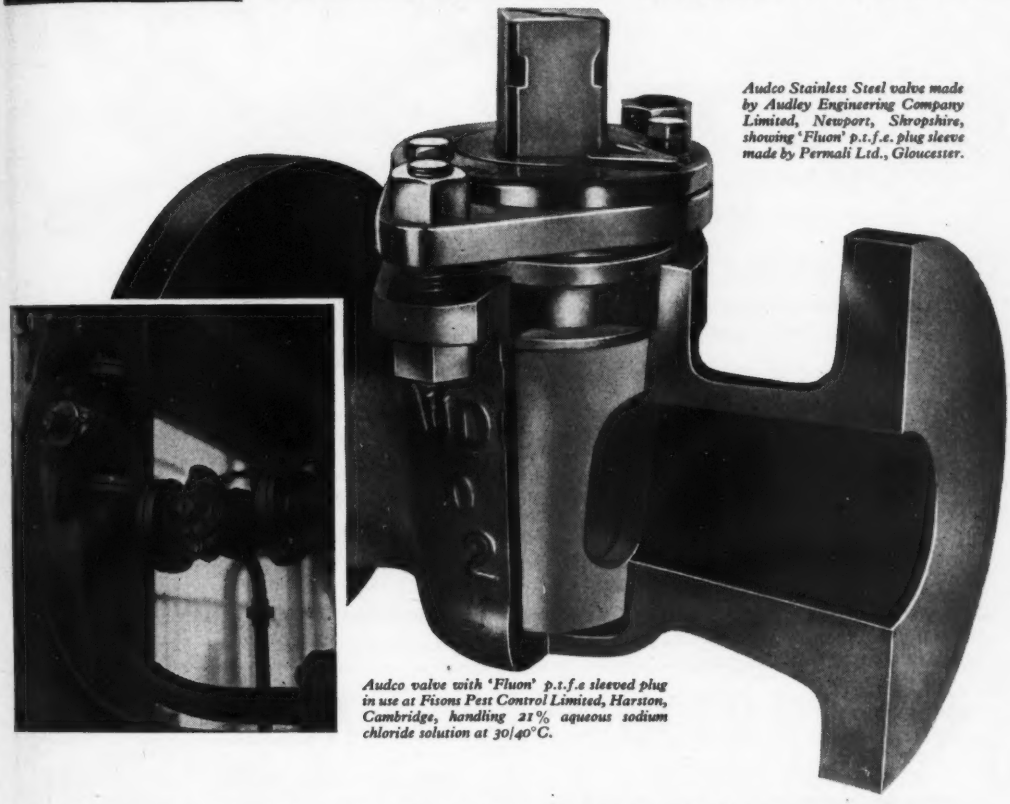

Audco Stainless Steel valve made by Audley Engineering Company Limited, Newport, Shropshire, showing 'Fluon' p.t.f.e. plug sleeve made by Permali Ltd., Gloucester.

Audco valve with 'Fluon' p.t.f.e sleeved plug in use at Fisons Pest Control Limited, Harston, Cambridge, handling 21% aqueous sodium chloride solution at 30/40°C.

Valves with 'Fluon' sleeved plugs handle any chemical without sticking or leaking and need no lubrication

THIS valve, made by Audley Engineering Company Ltd., can handle virtually any chemical at pressures up to 150 p.s.i. and temperatures up to 100° C. It requires a remarkably low turning effort, won't stick or gall, and never needs lubrication or any other maintenance. Its secret is that its plug has a thin sleeve of 'Fluon' p.t.f.e. compounded with a suitable filler for dimensional stability.

This is only one out of hundreds of products that benefit from the remarkable properties of 'Fluon'. 'Fluon' is an I.C.I. plastic material which is immune to virtually all forms of chemical attack. It has a working temperature from +250°C. down to at least liquid nitrogen temperatures, the best dielectric properties and the lowest coefficients of friction of any solid. It is also both tough and flexible.

Audco valves with 'Fluon' p.t.f.e. sleeved plugs in use at Fisons Pest Control Limited, Harston, Cambridge, handling chlorinated solvent containing ½% anhydrous H.C.L. at 95°C.

'FLUON' *'Fluon' is the registered trade mark for the polytetrafluoroethylene manufactured by I.C.I.*

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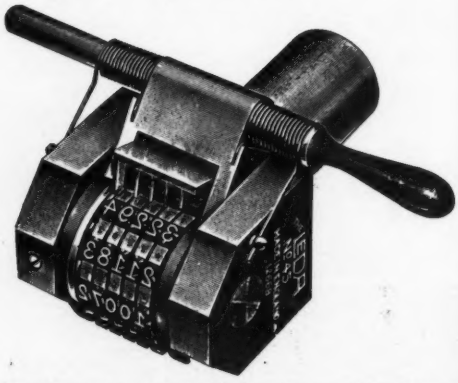

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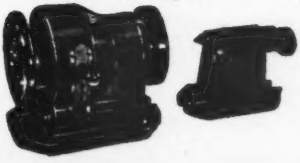

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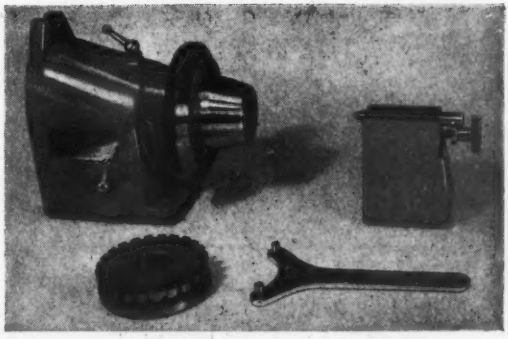

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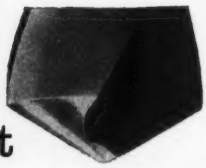

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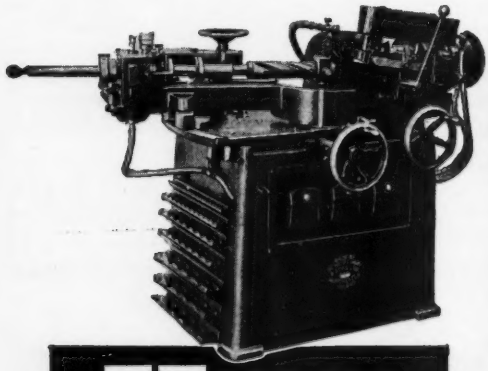

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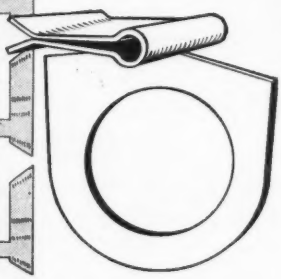

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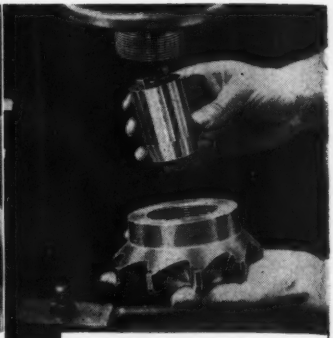
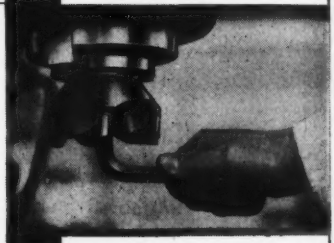


2 *Insert Marwin adaptor and screw on Marwin chuckmill to engage taper end.*



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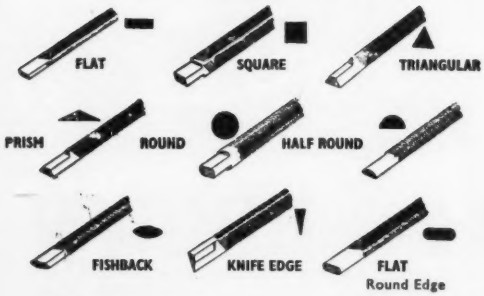

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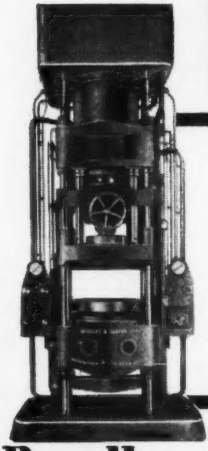

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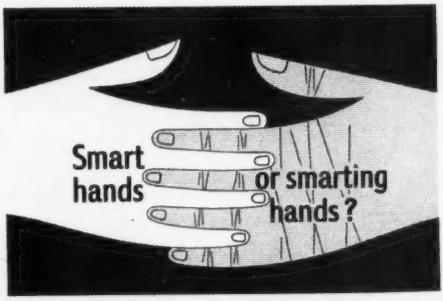

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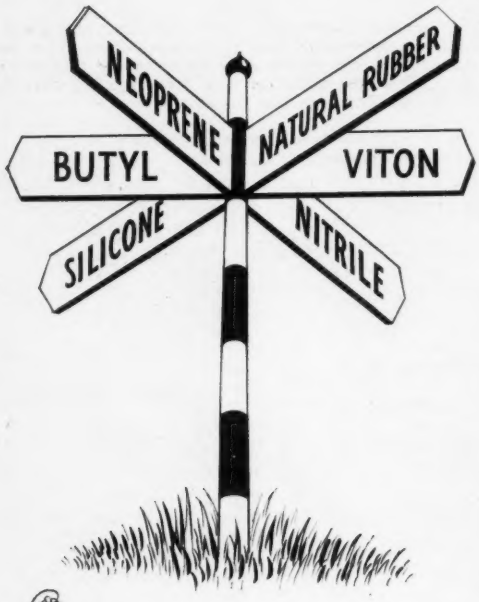

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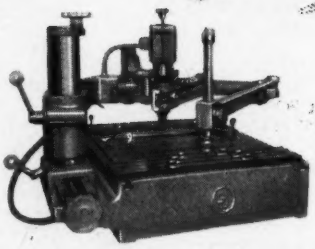

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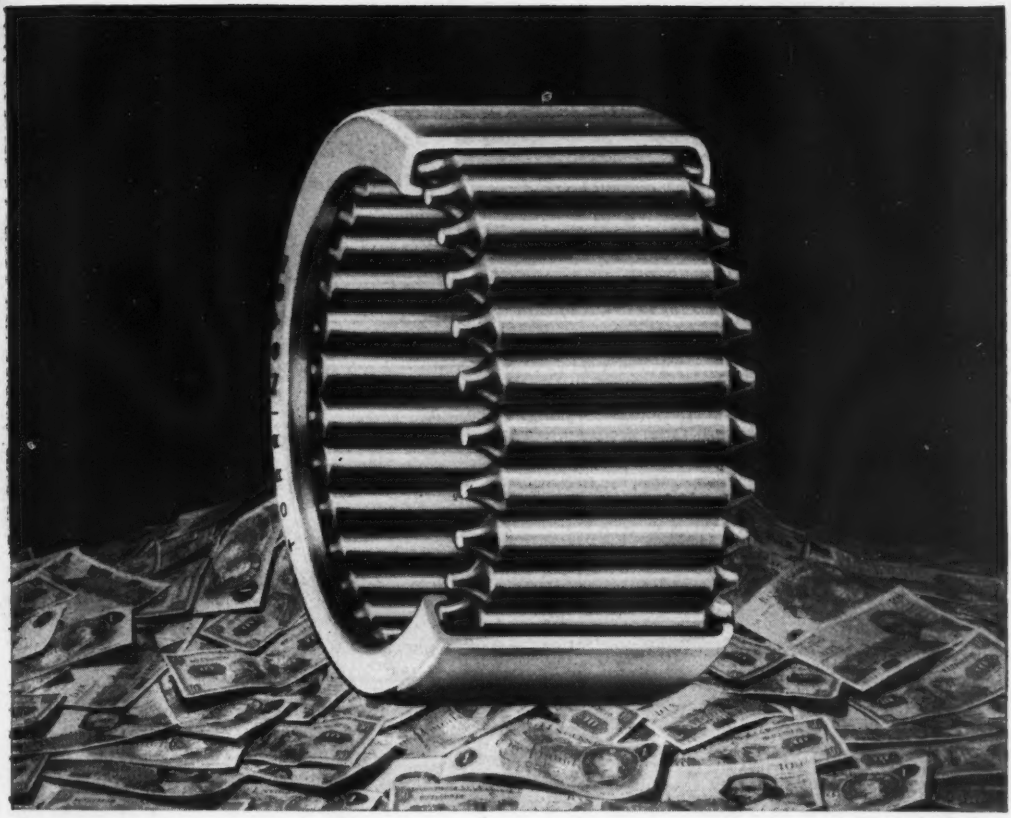

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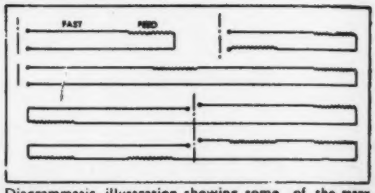

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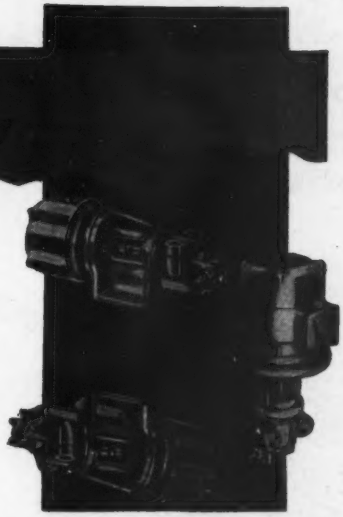

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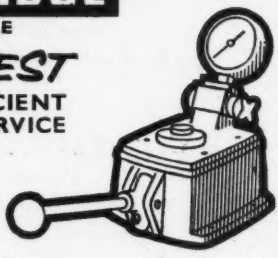

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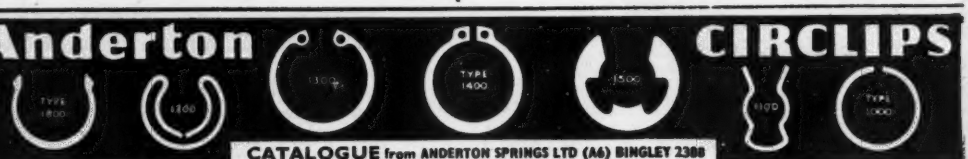

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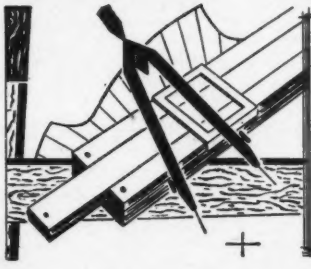

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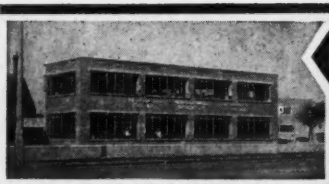

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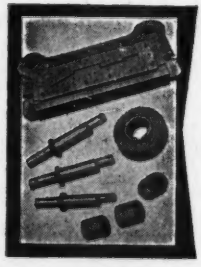

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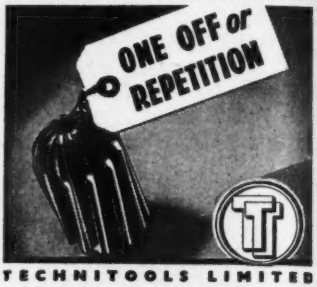

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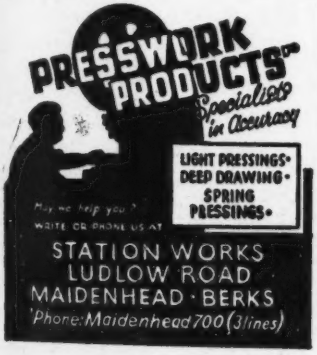

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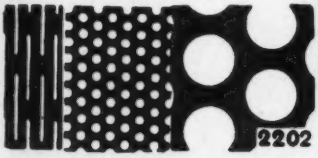

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Classified Advertisements (*PLANT FOR SALE, contd.*)

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Two Available

4ft. 6in. model speeds 31 - 830 r.p.m.
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Serial No. 20949 Straight Bevel Gear Generator. Double Roll.

Combination roughing and Finishing

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RYDERMATIC No. 12 Vertical Multi-Tool Lathe.

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FORST RIA5 Universal Vertical Broach for internal and surface broaching, 5 tons, 39½ in. stroke. 1952 machine.

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New **VOEST** Swivel Head Radial, 1in. capacity, 3ft. 3in. radius.

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MOPCO 39in. × 11in. Hydraulic Surface Grinder, with inclinable spindle for horizontal or vertical grinding.
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GISHOLT 1L Turret Lathes.
FOSTER No. 2B Turret Lathe.

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WARD, HAGGAS & SMITH 8½in. Gap Bed, 36in. between centres.
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ARCHDALE 14in. Manufacturing type.
CINCINNATI Type OK 18in. Horiz.
ARCHDALE 20in. Twin Overarm Horizontal. Table 40in. × 10in.
KENT-OWENS 1-8 Hydraulic Production.
MASERATI S900 Horizontal Dial Type. Table 55in. × 13¾in.
CUTTAT 15-412 HYPERMILL Kneeless Production. Traverse 47¼in. Table size 66¼in. × 15¾in. 15 h.p. Motor. 1952 Machine.
MILNES Sw. Hd. Vertical. Table 30in. × 8¼in.
HERBERT 23V Vert. Table 68in. × 17in., 48in. traverse.
HOLROYD TI17 Thread Miller.
HELLER Automatic Thread Millers (4).
ASQUITH HKO Duplex Keyseater.

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V & O No. 11 Double Action. Approx. 10 tons. Roll feed. Max. draw 1in.

All machines motorised 400/3/50 unless otherwise stated.

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Rapidmill No. 3 Horizontal Milling Machine.—C. DUGARD, LTD., Denmark Villas, Hove 32471.

No. 2 Edgwick Vertical Milling M/c, dial type. Table 46in. × 11in. Long. traverse 28in. Auto rotary table. Speeds 37-605 r.p.m. S.C. motor.—LEE & HUNT, LTD., Crocus Street, Nottingham. 'Phone: 84642.

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BORING MACHINES

WELLMAN RYDER Horizontal Boring Machine. Dia. of Spindle 3in.

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ADCOCK & SHIPLEY 28in. Vertical Heavy Duty Drill. (Two machines available.)

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DAVID BROWN MT30 Gear Hobbing Machine (1951).

CAPSTAN AND TURRET LATHES

MORINI-BOSSE Capstan Lathe. Dia. of hole through spindle 1⅜in.

WARD 3A Capstan Lathe.

WARD 7 Capstan Lathe. Covered Bed.

WARD 10/13 Combination Turret Lathe. Covered Bed.

S.S. & S.C. LATHES

SWIFT S.S. & S.C. 9in. by 60in. Gap Bed Lathe.

SWIFT S.S. & S.C. 12½in. by 90in. Gap Bed Lathe.

CHURCHILL-REDMAN Surfacing, Boring and Screwcutting Lathe. 24in. swing over saddle.

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CHURCHILL-REDMAN 18in. Heavy Duty Shaping Machine.

CHURCHILL-REDMAN 24in. Heavy Duty Shaping Machine.

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CINCINNATI No. 2 DIAL TYPE Horizontal Milling Machine.

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TRAUB Type A42 1¼in. cap. Swiss Automatic. New condition.
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DRUMMOND Model K, Chucker.
HERBERT 2S with air op. D/L Chuck.
TIMBRELL & WRIGHT 2A 1¼in. cap.
BENRATH 1¼in. cap. Bar Machine.

MILLING MACHINES

CINCINNATI Model 3-24 Hydromatic Hori. Production Mill.
ADCOCK & SHIPLEY Model 2AGU Universal Mill with vert. hd. and div. hd.
INDUMA Universal Mill, vert. hd., etc.
VICTORIA Model M1, Hori. Mill.
ATTNO Swivel Hd. Vertical Mill.
E.H.J. No. 55 Swivel Hd. Vert. Mill.
C.V.A. Model 79 Swiv. Hd. Vert. Mill.

GRINDING MACHINES

EXCEL No. 3 Hydraulic Surface Grinder, cap. 24in. × 8in., with mag. chuck, etc.
KAESER Hydraulic Surface Grinder, cap. 24in. × 8in., with mag. chuck, etc.
CAPCO No. 2 Surface Grinder, hand feeds.
EXE Surface Grinder, dust extract., etc.
CHURCHILL 6in. × 20in. Hydraulic Plain Cylindrical Grinder.
MYFORD Model MG9, 5in. × 9in. Cyl. Grinder, with internal attachment, etc.

MISCELLANEOUS

New **RATZER** 12 ton Power Press, adj. str
RAPIDOR 6in. Power Hacksaw.
RHODES 5ft. × ¼in. Power Guillotine.
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DELAPENA Honing Machine.

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New Process 100 kVA Seam Welder, 400/3/50.
British Federal 50 kVA Flash Butt Welding Machine. 400/3/50.
Fielding Hydraulic Pipe Bender, up to 8in.
200 Ton Fielding Downstroke Hydraulic Press, 14in. ram, 42in. stroke, 63in. daylight.
100 Ton Fielding ditto, 10in. ram, 72in. stroke, 99in. daylight
50 Ton Fielding ditto, 3ft. stroke.
Bliss 70 Ton Geared Double Sided Power Press. 400/3/50 supply.
3 Bliss No. 304 Vertical Single Action Drawing Presses, 7½in. stroke, 50 tons. American.
Bennie Punching, Shearing and Section Cropping Machine, 4½in. × 4½in. × ½in. angle.
Windsor 6-oz. Plastic Injection Moulding Machine.
Sedgewick Bending and Folding Machine, 6ft. × ½in., motorised.
"Pyramid" Bending Rolls, 9ft. 0in. × ½in.
200 Tons Tangye Hydraulic Straightening Press, bed 25ft. × 3ft., stroke 21in., motorised travelling table, 2 ram pump.
Hugh Smith Double Table Scarfing Machine, 13in. fixed stroke, from 16in. to 8ft. wide, 1½in. thick steel plates.
Crow, Harvey Punch, Shears and Angle Cropper, 18in. blade, 27in. throat, heavy duty.
Pels Punch Shears and Cropper, 12in. blade, shear ½in., takes 6in. × 6in. × ½in. angles.
Robertson Shears, ½in. capacity, 10 h.p., 28in. blade, 9in. maximum opening. (Two.)
Berry Plate Guillotine, capacity 4ft. × 1in., 18in. throat, 30 h.p. motor.
New 1-cwt. and 2-cwt. Hammers by Massey and Alldays & Onions, also 3-5-cwt. secondhand E.O.T. Cranes.
30 Ton Marshall Fleming, 29ft. span, cab control.
25 Ton Clyde, 21ft. 9in. span, cab control 1954. Can convert any span to 95ft.
20 Ton Vaughan 42ft. 3in. span. Unused.
20 Ton Morris Goliath, 35ft. span, 5 ton auxiliary.
10 Ton Heywood, 34ft. span. Unused.
10 Ton Morris, 32ft. 10in. span, cab control.
10 Ton, 60ft. span. 1955. (Two.)
7 Ton, 37ft. span. 1950. (Two.)
5 Ton, 37ft. span. 1944.
3 Ton Morris, 149ft. span. 1954.

FRED WATKINS (ENGINEERING), LTD., Coleford, Glos. 'Phone: Coleford 2271 (5 lines).

Kitchen & Wade H.5 Horizontal Boring and Drilling Machine, complete with Square Box Table and Auxiliary Revolving Table. Machine equal to new.

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NEW BINNS & BERRY S.S. & S.C. Gap Bed Lathe, 12½in. centres x 10ft. 6in. b.c. Standard Equipment

Immediate Delivery

W. FORREST. & CO. LTD.,
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Kitchen & Wade H.3 Horizontal Boring, Drilling and Milling Machine, with 9ft. 0in. Square Table and Auxiliary Table. New 1956. Excellent condition.

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MAS VR2 36in. Radial Drilling Machine.—New ex stock.—C. DUGARD, LTD., Denmark Villas, Hove 32471.

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LATHES

COLCHESTER 5in. Chipmaster. (June.)
COLCHESTER 7½in. Triumph. (Sept.)
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BROADBENT 8½in. (June.)
BROADBENT 10in. (June.)
CARDIFF 7½in. (June.)
CARDIFF 9½in. (Aug.)
WILLSON 7½in. Mk. V. (June.)
WOODHOUSE & MITCHELL 7in. (June.)
SV18R 7in. Toolroom. (May.)
BINNS & BERRY 12½in. (Aug.)

MILLING MACHINES

VICTORIA TV1 Turret Mill. (July.)
VICTORIA U2 Universal. (Stock.)
VICTORIA O2 Omnimil. (July.)
VICTORIA Junior Mil. (Stock.)
VICTORIA V2 Vertical. (Aug.)
VICTORIA V3 Vertical. (May.)
VICTORIA V4 Vertical. (June.)
VICTORIA V2 Rapidmil Vertical. (May.)
W. & M. 369 Turret Mill. (July.)
VICTORIA U3 Universal. (July.)
VICTORIA U2 Rapidmil. (Stock.)
RICHMOND No. 3 Vertical. (Stock.)
BEAVER Turret Mill. (June.)
MAAS FU2A Universal. (June.)
INDUMA 3U Universal. (May.)
GIEWONT No. 4 Vertical. (May.)
GIEWONT No. 2 Vertical. (May.)

GRINDERS

EXCEL No. 1 Surface Grinder. (Stock.)
BURDETT 18in. × 6in. Surface Grinder. (July.)
BURDETT 24in. × 8in. Surface Grinder. (June.)
ELB 24in. × 12in. Surface Grinder. (June.)
RIBON RUR500 Universal. (Stock.)

DRILLS

RICHMOND SR2 36in. Radial. (Stock.)
RICHMOND HB3/12 48in. Radial. (June.)
PROGRESS 3E 1½in. cap. Pillar. (Stock.)
PROGRESS 3A 1½in. cap. (Stock.)
PROGRESS No. 1 and 1S ¾in. cap. (Stock.)
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VICTORIA and **EXCEL** Rotary Milling Tables, all sizes. (Stock.)
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TWO WARD 3A Capstan Lathes. Both equipped ball chuck and bar feed.

TWO WARD 2A Capstan Lathes. Arranged collet chuck and bar feed.

DRUMMOND Model K Capstan Lathe, arranged for chucking. 2 1/16in. Hollow spindle.

ONE **HERBERT** 2B Capstan Lathe, arranged for chucking.

HERBERT 1S Capstan Lathe, part bar feed.

TWO MOREY 2G Capstan Lathes, arranged for chucking.

WICKMAN 1 1/4in. 5-Spindle Bar Automatic, well equipped turret tools, collets, bar feed, and tapping attachment.

HERBERT 1 1/4in. Single Spindle Bar Automatic, with equipment.

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CARSTENS 4 1/2in. by 20in. between centres S.S. & S.C. High Speed Precision Lathe, fully equipped with collets, chucks, etc.

CHURCHILL-CUB 5in. by 20in. between centres S.S. & S.C. Lathe, with chucks, pick-off gears.

KEARNS No. 2 Horizontal Boring and Facing Machine, with Vernier Height Gauge and Boring Bars.

PEARN-RICHARDS No. 2 Horizontal Boring and Facing Machine. With Vernier Height Gauge and Boring Bars.

KEARNS No. O.A. Production type Horizontal Boring Machine with 2in. dia. traversing spindle.

ARCHDALE 5ft. Radial Drilling Machine, No. 5 M.T. Tee slotted low base, approximately 4ft. by 6ft.

KITCHEN & WADE Heavy Duty Pillar Drill. Spindle bored No. 4 M.T. Rise and fall table 24in. dia., swings round column.

ARCHDALE Two-Spindle Relieving Drill, No. 1 M.T. Power feed and independent motor drive to each spindle. Table W.S. 36in. by 15in.

TWO HAHN & KOLB Two-Spindle Drilling Machines. Power feed and independent motor drive to each spindle, fitted 3/4in. drill chuck. Table W.S. 21 1/2in. by 9in.

DISKUS Vertical Spindle Surface Grinder, hydraulic feeds. Table 53in. by 10in. 14in. dia. segmental wheel.

CHURCHILL Model "O" Universal Tool and Cutter Grinder, capacity 8in. by 16in.

EDGWICK No. 1 Keyseating Machine.

BROWN & SHARPE No. 2 Universal Milling Machine. Table W.S. 46in. by 10in. Spindle speeds 30–1,300 r.p.m. With high speed Vertical Milling Attachment, Slotting Attachment, Universal Dividing Head, chuck, change gears, rotary table, etc.

CINCINNATI No. O.8 Vertical Milling Machine. Table W.S. 20in. by 6in. Spindle speeds 150 to 1,300 r.p.m.

THREE **HERBERT** O.V. Vertical Milling Machines, swivel head. Table W.S. 18in. by 5in. Spindle speeds 250-2,000 r.p.m.

TRIDENT V.O. Swivel Head Vertical Milling Machine. Table W.S. 30in. by 8in. Spindle speeds 130–800 r.p.m.

ARCHDALE 28in. Plain Horizontal Milling Machine. Table W.S. 49in. by 13in. Power feeds and rapid traverse.

EDGWICK 18in. Plain Horizontal Milling Machine. Table W.S. 26in. by 7in. Spindle speeds 30–600 r.p.m.

WOTAN 16in. Crank Shaping Machine.

ALBA 18in. Crank Shaping Machine.

THIEL No. 6 Radial Arm Tapping Machine, capacity 3/4in. Whit.

JONES & SHIPMAN "Electrotap", with quantity of leaders.

SUPERIOR Vertical Tapping Machine, capacity 1/2in. Whit.

SIX TURNER Spin Rivetting Machines, type R.S.5.

CANNING Centreless Polishing Machine, with motorised dust extractor.

EDWARDS 4ft. by 14g Power Guillotine.

TAYLOR & CHALLEN 10 Ton Inclinable Blanking Press, 1/4in. stroke.

All machines self-contained drive. 400/440 volts, 3 phase, 50 cycles.

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Newman

AUTOMATICS

BULLARD Multi-Au-Matic 7in. 8 spindle.
BULLARD Multi-Au-Matic 12in. 6 spindle.

BORING MACHINES

KEARNS No. 2 Horizontal Boring and Facing Machine, 3in. dia. travelling spindle.
KEARNS Model OC Horizontal Boring Machine, 3in. dia. travelling spindle.
ROCCO Model AL55D Horizontal Boring and Facing Machine, 2¼in. dia. travelling spindle. (NEW.)
KEARNS No. 4 Horizontal Boring and Facing Machine, 4in. diameter travelling spindle.
WEBSTER & BENNETT Vertical Boring Machine, table 50in. diameter.
RICHARDS Type PRT Horizontal Floor Boring Machine, 3½in. travelling spindle, 28in. diameter facing head.
GIDDINGS & LEWIS No. 45 Horizontal Boring Machine, 5in. diameter travelling spindle.

CAPSTAN AND CENTRE LATHES

CHURCHILL-REDMAN Model 13NM Heavy-Duty S.S. & S.C. Gap Bed Centre Lathe, 15in. centre height × 72in. between centres. Swing in gap 50in.
MITCHELL Model DM10 S.S. & S.C. Gap Bed Centre Lathe, 10¼in. centre height × 7ft. 5in. between centres. (NEW.)
OLDFIELD & SCHOFIELD Surfacing and Boring Lathe, 10¼in. centre height.
WARD 7B Combination Turret Lathe.
NILES Heavy Duty Centre Lathe, S.S. & S.C. 17in. centre height × 28ft. between centres.
U.L.R.O. Heavy Duty Centre Lathe, 16in. centre height × 30ft. between centres.

DRILLING MACHINES

HETTNER Radial Drilling Machine, 10ft. elevating arm.

GEAR MACHINES

ORCUTT Model HM24 Hydraulic Internal Gear Grinder.
GLEASON 3in. Straight Bevel Gear Generator

GRINDING MACHINES

CHURCHILL Plain Cylindrical Grinding Machine, 26in. swing × 84in. between centres (1951).
LANDIS Type C Plain Hydraulic Cylindrical Grinding Machine, 6in. swing × 18in. between centres.
LANDIS Plain Hydraulic Cylindrical Grinding Machine, 18in. swing × 72in. between centres.
ORCUTT Model HM24 Internal Spur Gear Grinding Machines.
CHURCHILL Plain Hydraulic Cylindrical Grinding Machine, 20in. swing × 72in. between centres.
BROWN & SHARPE Plain Cylindrical Grinding Machine, 10in. swing × 36in. between centres

MILLING MACHINES

CINCINNATI No. 3 High Speed Dial Type Vertical Milling Machine (1950).
CINCINNATI Model 5/72 Plain Hydromatic Milling Machine, table 91in. × 22in. (1952).
CINCINNATI No. 2L Plain Horizontal Milling Machine, table 52in. × 10in.
CINCINNATI No. 1M Vertical Milling Machine.
CINCINNATI No. 4 Dial Type Horizontal Milling Machine.
GRAFFENSTADEN Model F1101 Plain Horizontal Milling Machine, table 52in. × 10in.
PRATT & WHITNEY Model BL3620 3-spindle "Keller" Die Sinking Machine.
CENTEC Model 3R Automatic Production Milling Machine, table 25in. × 16in.

MISCELLANEOUS

LANGE & GAILEN 28in. stroke Double Headed Hydraulic Shaping Machine.
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BRADLEY & CRAVEN Geared Press Brake. Motorised for 400-440/3/50 supply. Max. pressure approx. 65 tons. Forming capacity 10ft. × 12 s.w.g. over die opening of ½in., or 8ft. × ½in. over die opening of 1½in. Depth of gap 7½in. Fitted with goats foot top tools and bottom dies. Weight approx. 8½ tons.

BESCO Eccentric Power Punching Press. Motorised for 400-440/3/50 supply. Pressure exerted approx. 8 tons. Stroke adjustable from ½in. to 1½in. Bed 11½in. × 8½in. Hole in bed 4½in. × 3½in. Weight approx. 720lb.

TWO NEW LEN.40/250 Open Fronted Inclinable Power Presses. With adjustable stroke. Motorised for 400-440/3/50 supply. Pressure exerted 40 tons. Depth of throat 9½in. Adjustment of stroke ½in. to 3½in. Table 18½in. × 25⅝in. Hole in table 8½in. diameter. Weight approx. 58 cwt.

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CLOVER 6in. × 31in. between centres, with or without hydraulic copying equipment.
RI Type M210, 8½in. × 59in. between centres.
RI Type M250, 10in. × 59in. between centres.

MILLERS

CONTI Type 2 Universal, 51in. × 12½in. table
CONTI CSE.1500 Universal. Table size 67in. × 12⅝in.
BCD Model A Universal, 43in. × 9in. table.
BCD Model N Universal, 34in. × 8½in. table.
AUERBACH Hand Lever Mill. 16in. × 5in. table size.
BEAVER Type "A" Turret Miller.
SCHUBERT Hand Lever Horizontal Bench Machine. Table size 14in. × 5½in.

SHAPERS

FIL 25in. stroke, with swivel table and automatic down feed.
FIL 29in. stroke, as above but with rapid table traverses.

BORERS

UNION BFT63. 2½in. spindle machine complete with facing head.

DIE FILING AND SAWING MACHINES

LIMATIC B12. Table 11½in. × 11½in., stroke 1⅝in.-5in., throat 6½in.

DRILLS

BREDA R914L Radial, 1½in. dia. × 36in. swing.
I.M. ½in. capacity. High speed bench Drills.
I.M. ⅝in. capacity. High speed bench Drills.
I.M. ¾in. capacity. High speed bench Drills.
I.M. ⅞in. capacity. High speed bench Drills.
I.M. 1in. capacity. High speed pedestal Drill.
I.M. 3 spindle ⅞in. capacity. High speed Multi-Head Floor Mounted Drill.
SOLBERGA 1in. capacity Bench Drilling Machine.
PACERA ½in. capacity Bench Drill.
PACERA ⅝in. capacity Bench Drill.
ELHA 1⅜in. capacity Column Drill.
ELHA 2⅞in. capacity Column Drill.
TOS V40 1⅜in. capacity Column Drill. Sliding head.

GRINDERS

TOS BPV300/1000 Vertical Spindle, 12in. × 13½in. table.
TOS BPV700/1000 Vertical Spindle, 24in. × 118in. table.
MONZESI 250 Centreless, ⅛in.-1in. dia.
M.F. Bench Surface Grinder. Table size 11⅛in. × 6in.

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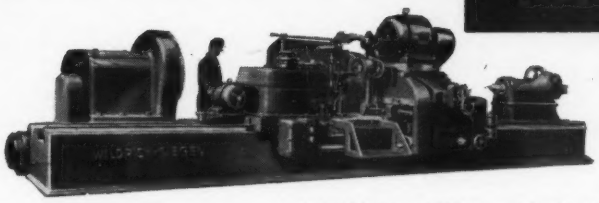

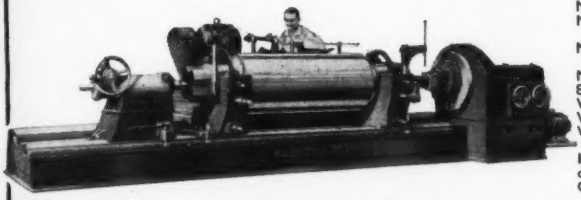

"WALDRICH SIEGEN" model WS 2B traversing wheelhead type roll-grinding machine, with built-in variable automatic cambering mechanism for producing both concave and convex cambers on the roll surface.

Maximum diameter of roll ground	38in.
Maximum length of roll face ground (with heavy duty roll supports in position) ...	8 ft. 4in.
Maximum length of roll face ground (without supports)	13ft.
Maximum distance between centres	13ft.
8 workhead speeds	6-57 r.p.m.
Workhead motor...	10 h.p.
Wheel size	24in. by 3in.
Wheelhead motor	20 h.p.

Headstock has 24in. diameter faceplate, with a specia driver for driving the "wobblers" of steel mill rolls Overall floor space required for the machine is 25ft. by 9ft

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KEARNS No. 3 Facing Machine. Maximum distance facing head to steady 10ft. 3in., maximum diameter faced 42in. 24 Spindle speeds. 8 feeds. Motorised 400/440 v., 3 phase, 50 cycles.

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Angle Cropping Machine. Cap. up to 6in. × ½in. angles.

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MILWAUKEE 3.H Vertical Milling Machine.

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BRADLEY & TURTON No. 3 Flypress.

SWEENEY & BLOCKSIDGE Bench Press. Capacity 3 tons.

SCREWING MACHINES

KENDALL & GENT 3in. Screwing Machine

POLISHING MACHINES

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SLOTTING MACHINES

ORMEROD 12in. Stroke Slotting Machine.

All machines 400/3/50 electrics unless otherwise stated.

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NOBLE & LUND 11in./16in. Fluidfeed Cold Sawing Machine with fluid grip vice Capacity 5in. dia. rounds, 4¼in. squares 3 speeds, 5 h.p., 400/3/50.
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RUSHWORTH Geared, Overcrank, Power Guillotine. Capacity 10ft. × ¼in. m.s. 20 strokes per minute. Motorised 15 h.p., 400/3/50. Complete with automatic hold-down, front and rear gauges, fully guarded and spare pair of blades.
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STANCROFT LTD.,
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Jones & Shipman Fig. 540 Hydraulic Surface Grinder, 18in. × 6in. cap., 14in. × 6in. chuck, 400/3/50 electrics. Also Abwood 13in. × 7in. Motorised Vertical Spindle Surface Grinder, hand feeds. Good cond.—C. L. THOMAS, LTD., Stirling Road, Solihull. Tel.: 3075-6.

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**15in. Centre "Dean, Smith & Grace" Type 4/9D m/d. all-gd. S.S. & S.C. Lathe with taper turning attachment. 11ft. box end gap bed. 5ft. 6in. b.c. 48in. dia. in gap. 5 h.p. 415/3/50 motor. 16 spindle speeds 9-180 r.p.m. Spindle bored 3⅛in. dia.—LEE & HUNT, LTD., Crocus Street, Nottingham. 'Phone 84246.

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Kearns Horizontal Boring Machine. Model "O." Table dimensions 36in. × 36in., longitudinal traverse 40in., transverse motion 15in. Spindle bore No. 5 morse taper. Speeds 72 to 620 r.p.m. Three speed motor. Cheap to clear.—BOX C557, MACHINERY, Clifton House, Euston Road, N.W.1.

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BROWN & SHARPE No. 2 Surface Grinder.
STUDER Model PSM.150 Profile Grinder. This machine is in excellent condition.
HORTSMAN Thread Grinder, capacity 5in. dia. × 9in. b.c.
BROWN & SHARPE No. 5 Cylindrical Grinder.
FRITZ WERNER Model 270A Cylindrical Grinders, 3½in. × 7in. b.c.
BROWN & SHARPE No. 13 Universal Grinder.
BRYANT No. 5 Heavy Duty Internal Grinder.
BENTLEY Form Cutter Grinder.

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BOYES & EMMS S.S. & S.C. Lathe, centre height 16in. × 7ft. 6in.
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SWIFT Hydraulic Copying Lathe, 36in. swing × 5ft. 6in. b.c., 30 h.p. drive.
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RIVET 4in. × 18in. b.c. Precision Lathe.
LE BLOND 14in. × 24in. S.C. Lathe.
BOLEY LEINEN L.4 2nd Operation.
WARNER & SWASEY No. 3 Capstan

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CINCINNATI 1-18 Production Miller.
KENDALL & GENT Vertical Miller, table 69in. × 19in., speeds 20-300, rapid traverses.
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SCHIESS DEFRIES Vertical Keyseater.
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FRITZ WERNER 10in. × 34in. Horizontal Mill.
BROWN & SHARPE No. 2 11in. × 49in. Horizontal Mill, speeds 15-376. Feeds 3/10-15 I.P.M.

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30-ton **RASKIN** Double Sided Double Geared Drawing Press. Area 20in. × 23in. Draw 4¾in.
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DOWDING V8 Gear Hobber. Max. pitch in steel one cut 14 D.P.; in soft metals one cut 12 D.P. Max. dia. 0in.-8in. No. of teeth cut 6-400. Length of hobbing traverse 7½in. Hob spindle speeds (10) 61-246 r.p.m.

DRILLS

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CORONA 13in. 2AP Sensitive Pedestal Drill.
CORONA 20in. Pedestal Drill.
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MISCELLANEOUS

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CINCINNATI Model 4HP Heavy Duty Vertical Milling Machine. Table 72in. × 19in., speeds 17 to 480 r.p.m.

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WARD No. 7 Capstan Lathe with covered bed, speeds 37 to 1,000 r.p.m.

WARD No. 3A Chucking Capstan Lathe, 13in. swing. 1¾in. Hollow spindle, speeds 42 to 825 r.p.m.

SWIFT 12½in. Centres Gap Bed S.S. & S.C. Lathe, 6ft. between centres, 400/3/50.

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DENHAM 9in. Centres S.S. & S.C. Lathe, 4ft. 6in. between centres, with taper turning attachment.

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KAESER (Swiss) 10in. × 40in. Hydraulic Plain Cylindrical Grinding Machine, Excellent condition.

GLEASON 12in. Straight Bevel Gear Generator Serial No. 20949. Double Roll, combination Roughing and Finishing. Full equipment.

DAVID BROWN Model MT.30 Spur and Spiral Gear Hobbing Machine. Capacity 30in. dia. × 8in. face or 11¾in. dia. × 12½in. face, 3 D.P. Full changewheels.

PFAUTER 24in. Universal Gear Hobbing Machine. Plain and Tangential feed hob slide.

PFAUTER Hob Grinding Machine.

ASQUITH O.D.1 4ft. 6in. Radial Drilling Machine, No. 5 m.t., speeds 31 to 830 r.p.m.

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HERBERT HUNT Tap and Reamer. £65.
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SMART & BROWN Internal Grinder, 1¼in. Max.
NORTON 18in. × 7in. Hyd. Cyl. Grinder. £395.

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STANLEY 7in. × 36in., full Equip.
HASSE & WREDE 10in. × 42in.
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HERBERT 2as Tooling and Collets.
OLDFIELD & SCHOFIELD 15in. × 60in. £650.
HERBERT SMALLPEICE, 6in. × 24in. Multi-tool.
RIVET Instrument Lathe, 4½in. × 24in.

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CENTEC No. 3R Auto-cycle, pro mill.
HEY Duplex Spline Mill. £175.
ADCOCK & SHIPLEY IVM Vert. 25in. × 7in. As new.

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THIEL Filing and Sawing Machine. £95.
HURTH Key Seating Machine. £225.
THIEL Punch Shaper.
ORMEROD 12in. Shaper with Cam Cutting Attach.
AEROGRAPH Twin Cylinder comp. 100 p.s.i.
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PFAUTER 000 Gear Hobber, with gears. £150.

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Norton Universal Grinding Machine. 1942. Size 12in. × 36in. Condition good. External/internal equipment.—BOX C679, MACHINERY, Clifton House, Euston Road, N.W.1.

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New **TOWN** 4ft. 6in. AE1 Radial Drilling Machine.
KITCHEN & WADE 6ft. Girder Type Radial Drilling Machine, 18 spindle speeds, 6 feeds. No. 5 M.T. spindle, motorised 400/3/50 supply.
ARCHDALE Column Type Vertical Drilling Machine, compound table 27in. × 16in., No. 4 M.T. spindle. Motorised 400/3/50 supply.
ASQUITH Model O.D.1 6ft. Heavy Duty Radial Drilling and Tapping Machine. Motorised 400/3/50 cycles, with loose box drilling table.

BORING MACHINES

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WEBSTER & BENNETT Series D 36in. Single Column Type Vertical Boring Mill, motorised 400/3/50 supply.

SLOTTING MACHINES

ORMEROD 12in. stroke Slotting Machine, 27in. dia. rotary table, motorised 400/3/50 supply.

LATHES

LANG 12½in. Gap Bed S.S. & S.C. Lathe, to admit 10ft. 6in. between centres.
CRAVEN 15in. S.S. & S.C. Lathe, to admit 25ft. between centres.
LANG 15in. Centre Lathe, two saddles, admit 17ft. 6in. between centres, motorised 400/3/50 supply.

MILLING MACHINES

C.V.A. "Kearney & Trecker" model 2E Dial Type Horizontal Plain Milling Machine, working surface of table 41in. × 12in., longitudinal feed 29in., cross feed 12in., 8 spindle speeds 25/1,000 r.p.m., motorised 400/3/50 supply.
CINCINNATI Model 3/36 Hydromatic Milling Machine, table 54in. × 14in., motorised 400/3/50 cycles.
MANN Vertical Milling Machine, with swivel head, dial change to spindle speeds and feeds, table 46in. × 12in., 9 speeds, 48/750 r.p.m., motorised 400/3/50 supply.
KENDALL & GENT CVM25 Vertical Miller, size of table 66in. × 19in., longitudinal feed 54in., 18 spindle speeds 15/840 r.p.m., motorised 400/3/50 supply.

BROACHING MACHINE

CINCINNATI 10 ton Vert. Single Ram Hydraulic Surface Broaching Machine, 66in. stroke 20in. × 20in. table, motorised 400/3/50 cycles

GRINDING MACHINES

JONES & SHIPMAN Fig. 540 Horizontal Spindle Hydraulic Surface Grinder, table 18in. × 6in., motorised 400/3/50 cycles.

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New **BUTTERLEY** B3½ Geared Open Fronted 75 Ton Power Press, 1in.-5in. adjustable stroke.
New **BUTTERLEY** No. 4, 20 Ton Ungeared Power Press, 1in.-3in. adjustable stroke.

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NOBLE & LUND 24in./28in. Cold Circular Sawing Machine, 10in. dia. rounds, 9in. squares, 18in. × 7in. beams, motorised 400/3/50 cycles.

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KENDALL & GENT 3-2 Tangential Head Screwing Machine, to screw bolts up to 2in. outside diameter, tubes up to 3in. inside diameter, machine fitted with leadscrew, motorised 400/3/50 supply.

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New **MORGAN** 6ft. × ¼in. Undercrank Guillotine Shearing Machine.

MISCELLANEOUS

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All the above machines are motorised 400-440/3/50 cycles.

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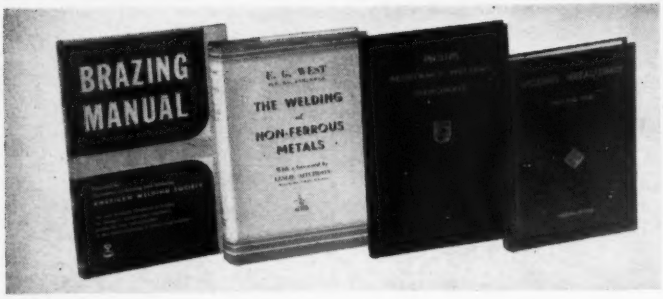

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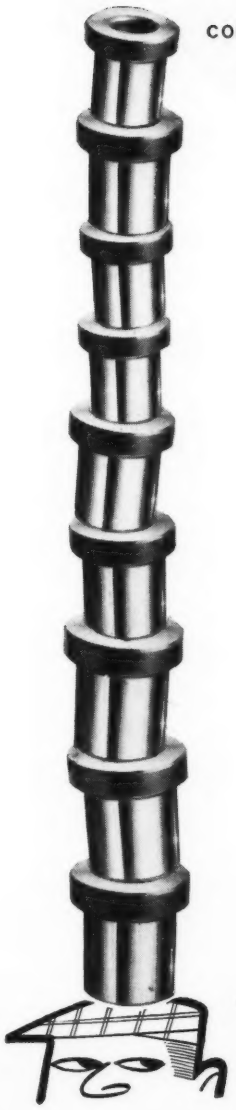

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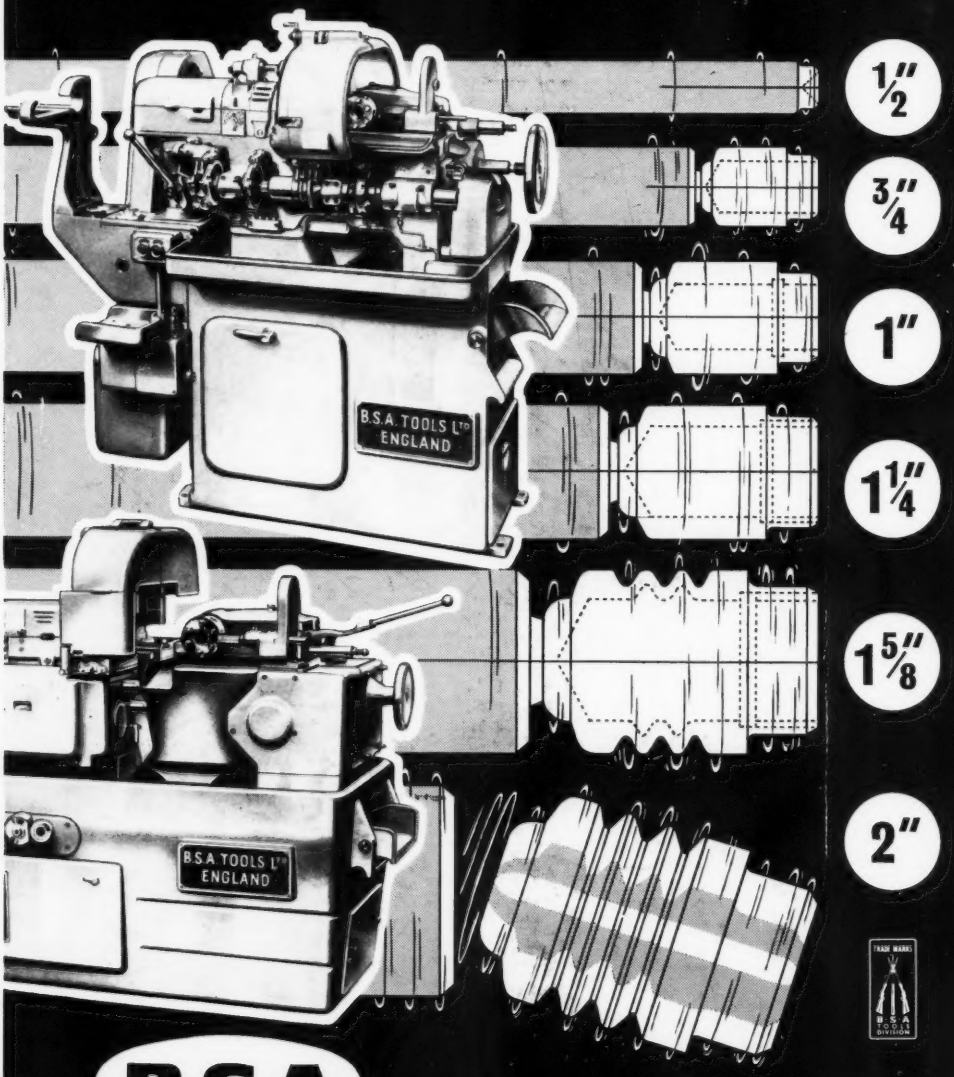

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